

Subterranea

The Magazine for Subterranea Britannica



Subterranea Britannica



April 2018 Issue 47

IN THIS
ISSUE

Gibraltar Study Tour
Portsmouth & IOW Visit 2017

Surrey Hearthstone Mining Industry
Sub Brit Visit to RNPf Caerwent

Subterranea Britannica is a society devoted to the study of man-made and man-used underground structures and the archaeology of the Cold War. The society is open to all and its membership includes all walks of life. Members are invited to contribute to this magazine even if this just means sending very welcome snippets from newspapers and magazines.

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- Front cover photo:** Lengths of prefabricated Decauville track and an abandoned wheel-set in one of the entrance headings in Marden Quarry near Godstone, Surrey. As in the other underground quarries in the Godstone area, it is probable that the more modern rails were laid during the 20th century during the revival of trade due to the short lived boost in demand for hearthstone. Photo Nick Catford
- Back page upper:** The Sub Brit group pose for the camera at Fort Widley on the second day of the Portsmouth and Isle of Wight weekend. Photo Gerald Tompsett
- Back page lower:** The second Sub Brit party gingerly edge along the calcite ledge formed by the calcium bicarbonate-saturated water around the underground lake in Lower St Michael's Cave in Gibraltar. The lake is some 30 metres long, with a width about one third of that and a depth of up to six metres! Photo Clive Penfold

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However the Editor reserves the right not to publish material without giving a reason.

The committee of Subterranea Britannica and the Editor do not necessarily agree with any views expressed and cannot always check the accuracy of any material sent in.

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Chairman's Welcome

Martin Dixon

I'm penning this shortly after Sub Brit's return visit to RAF Daws Hill where ninety members were able to visit this iconic US Air Force bunker dating from 1942. The visit brought out Sub Brit at its best, featuring as it did the different characteristics of the three sets of players involved:

- 1) An excellent relationship with the site owner
- 2) Willing volunteers to help arrange and support our visit
- 3) Well-informed members which leads to lively discussion and helps welcome new members.

A short summary of our revisit appears elsewhere in this edition. I'm hopeful that future visits will be possible to this important site which played a pivotal role in the prosecution of World War II and the prevention of World War III.

The Committee has spent much time recently discussing future systems which is planned to lead to new platforms for membership, event booking and our site records. There are two main drivers, firstly to ensure that our systems are well integrated and easy to use. For example, the plan is for more of our members to be able to add details and photos about sites onto our public-facing website. We also plan to incorporate information and articles from previous editions of *Subterranea* which will help fill in some of the gaps and update older records.

Secondly, we are currently hugely dependent on (and endlessly grateful to) our Webmaster Richard Seabrook and the changes will move us in general onto managed services, away from running packages on our own server as happens today. Our Members' Forum has already moved to be a hosted service which I'm sure you'll

agree was largely transparent thanks to Richard's careful planning.

While on the subject of our Forum, can I remind members to follow the usual etiquette when online. In particular:

- * Please use the 'like' button rather than add a 'thank you' message
- * Move bilateral discussions/replies off the Forum
- * Don't post a question that Google can answer in ten seconds (other search engines are available!).

All the above can serve to irritate and waste time for other members.

It's worth reminding everyone that the Forum is searchable – not only for recent posts but also of the archive of emails from our previous system (dating back to 2004). Try using the search facility before posing a question that may already have been answered. May I also publicly thank all the Moderators who keep the Forum clean and tidy for the rest of us to enjoy.

Data Protection for Members is taken seriously and any systems changes will of course pay full attention to the imminent GDPR (General Data Protection Regulations) legislation. We are in the process of producing a Privacy Notice for *Subterranea Britannica* which will document the personal data we hold and how we use it.

Finally, RAF Daws Hill is just one of a number of visits and events that mark a busy start to the year. I need no excuse to thank once again all those who put in the effort to arrange trips for fellow members, and I'm hoping to meet many of you at some of these events.

chairman@subbrit.org.uk

Chris Rayner Commemorative Plaque

Many Members will recall the sad and unexpected passing of Chris Rayner in April 2017. One of Chris's responsibilities was administering Sub Brit's charitable grants, one of which last year was made to the project to reopen Mail Rail as a public attraction.

The Committee felt that this offered a way to publicly record our fondness and respect for Chris and so, with the support of the Post Office Museum, we affixed a plaque recording Chris's life and his contribution to our society.

It is now in proud place by the boarding area for the new passenger trains and therefore seen by literally thousands of visitors per week. If you visit the excellent Mail Rail museum – either on a public tour or a Sub Brit 'behind the scenes' visit – be sure to look out for it and raise your hard hat to a great man.



Photo Adrian Armishaw



SUBTERRANEA BRITANNICA DIARY

Summary of Forthcoming Events

Sub Brit specific events

2018

- 11-14 May SB Budapest Study Weekend
- 7 June Paddock Open Day
- 8 June RAF Lakenheath Visit
- 9 June SB Committee Meeting
- 1 July Copy deadline for *Subterranea* 48
- August *Subterranea* 48 published
- 25 August Surface walk – Woldingham to Oxted Station, Surrey
- 22 September Paddock Open Day
- 19 October SB Committee Meeting
- 20 October SB Autumn Meeting, Nottingham
- 21 - 22 October SB Visits Days, Nottingham
- 1 November Copy deadline for *Subterranea* 49
- December *Subterranea* 49 published
- 26 January 2019 SB Committee Meeting

Other underground-related events

2018

- 4 - 7 May Railway & Canal Historical Society AGM, Wrexham
- 12 May Reigate Caves Open Day: 10:00 - 16:00
- 1 - 4 June NAMHO Conference 2018, Forest of Dean
- 9 June Reigate Reigate Caves Open Day
- 16 June Cuckfield ROC Post Open Day (11:00 - 16:00)
- 23 - 27 June AIA Conference, Caithness
- 7 - 8 July Cuckfield ROC Post Open Days
(Sat: 11:00 - 16:00; Sun 10:00 - 14:00)
- 14 July Reigate Caves Open Day
- 6 - 9 & 13 - 16 September Heritage Open Days, England
- 22 - 23 September London Open House
- September (tbc) Heritage Open Days, Scotland, Wales & N. Ireland

2019

- 20 - 26 May Hypogea, Bulgaria

For web links to these events please visit www.subbrit.org.uk/events
or contact the Society concerned

*If you know of other relevant events run by other societies, please let us know
so that they can be advertised in the next edition and on the website*



Summary Minutes of Committee Meeting 27 January 2018 at Goldwater Lodge , Woking

By Sub Brit Secretary, Linda Dixon

Attendees: Martin Dixon, Linda Dixon, Tony Radstone, Nick Catford, Bob Templeman, Paul Sowan, Jason Hughes, Chris Gray, Richard Seabrook, Tim Wellburn. Apologies: Alistair Graham Kerr, Phil Catling, Richard West.

Commemorating Chris Rayner

A plaque has now been installed at Mail Rail. There will be a photo in the next *Subterranea*.

Health and Safety

This is a standing item on our Agenda. Bob reports concerns about the light fittings in Paddock and will raise with the owner. We offered Sub Brit's help with the fixing if required.

Preparation for the AGM

Financial data is with our Accountant to produce the Accounts. Annual Report produced by Martin and signed off. Linda will manage the process to send out Agendas and documents and make sure they are up on the web. Nominations for the Committee were taken.

Grants and Projects

There are no new applications for Grants; Tim will progress the two proposed previously.

New Data Protection Legislation

Phil has started to look at this to determine the implications for Sub Brit. The first step is to ensure that we each delete any local copies of data not required, so that we are left with just a central repository.

Shop Stock Management

Bob is holding lots of stock and we decided to try and reduce the amount. We will reduce the cost of the very old SubTs, and even give them away at some events. Nick will minimise the number of future magazines printed.

Future Systems

Richard Seabrook is keen to move our systems to new platforms to ensure their safe management. This will be debated further using the Committee section of the Forum.

Day Meetings

Spring Meeting planning is underway for 14 April at the Royal School of Mines, London. The Autumn Meeting in 2018 will be in Nottingham on 20 October, followed by visits on Sunday 21st/Monday 22nd.

Visits/Trips

Tony, Linda & Martin are working on the weekend trip to Budapest in May; this is hard work as responses are poor. Other ideas for overseas and UK weekends welcomed.

Day Visits/Trips

The first of the Mail Rail trips is on 5th Feb; Richard W and Tim will host. The booking & ballot seemed to go OK. New dates will be sought for the other trips. Other trips in the planning – Daws Hill (23 March, Martin); Grantham/Witham (7 April, Chris), Thames Tideway (13 April, Linda), Paddock (7 June, Bob), Lakenheath (8 June, Tony), Northampton bunker (tbc), Cornwall Mines (tbc) and Caerwent (tbc).

Sub Brit 'Flyer'

Linda produced some new designs. One was selected and Linda will work to get this produced.

SURFACE WALK

Surface walk with Paul Sowan: Woldingham Station to Oxted Station Saturday 25 August 2018

This walk over the top of the 2266 yards Oxted railway tunnel, driven in 1865 – 67 and 1880 – 1884, is to see aspects of the engineering of what was at first to have been the Surrey & Sussex Junction Railway but was completed after abandonment for 13 years as the Croydon, Oxted & East Grinstead Railway.

The tunnel is very unusual in being driven on a curve throughout its length, and therefore significantly longer than it might have been. The route is footpaths through woodland including a steep downhill scramble at one point, followed by quiet residential roads into Oxted, where there is a pub at the station.

Meet at Woldingham Station at 14.00. Return by train through the tunnel from Oxted.



NEWS

Miscellany compiled by Paul Sowan and Nick Catford

NEWS – ARCHAEOLOGY

Neolithic drift mining for flint reported, West Sussex

Neolithic flint mines have been excavated and reported from numerous places in Europe, including Norfolk and West Sussex in the UK, and Belgium, the Netherlands and Poland in mainland Europe. Hitherto, these mines have taken the form of wide vertical shafts with short tunnels radiating along the flint seams at the bottoms.

A recent report from West Sussex has now provided preliminary evidence for a drift mine in which flint was reached by tunnelling laterally rather than via shafts. The cited report includes a photograph captioned ‘The blocked entrance to a drift mine’ at Harrow Hill, a location near Worthing where shaft mines have long been known.

SOURCE: BACZKOWSKI, Jon, and Robin HOLGATE, 2017, Breaking chalk: the archaeological investigation of early Neolithic flint mining at Long Down and Harrow Hill, West Sussex, 1984–86. *Sussex Archaeological Collections* 155, 1–29 [Reports a drift mine for flint at Harrow Hill]

Ancient cave paintings in Chile damaged by graffiti

If you wanted to feel irrationally angry today, look no further than the Anzota Caves in Chile. In late February 2018 it was discovered that ancient cave paintings at the Anzota Caves in Chile had been badly damaged with graffiti. Although the graffiti aren’t recent nothing has been done to secure the area or to try and minimise the damage.

The Cuevas de Anzota, south of the city of Arica, is a series of caves inhabited by indigenous people in the pre-Columbian times. The graffiti have covered the ancient drawings of animals and vessels typical of the region. The vandalised area was never actually open to the public, but other parts of the caves and mountain have recently been through a restoration project to increase tourism, and have been open to the public since the 1960s.



A poster outside the cave warns ‘Archaeological Site preserved for future study and enhancement’. The Minister of Public Works says the site hasn’t been cleaned for fear of doing further damage. It has recently also been noted that the caves have been strewn with rubbish and are now smelling of urine. It is hoped that now the authorities have been made aware of the damage the government might be forced to improve the care and security of the caves.

SOURCE: *Science Alert*, 12 March 2018.

Three samples to be carbon-dated, Surrey

The Wealden Cave and Mine Society are to have three samples from east Surrey radio carbon-dated. Two are from underground quarries near Merstham: a piece of wood thought to have been used as a torch, and a fragment of a possible harness. The extensive tunnelled quarry complex is thought to be largely of medieval date. The third sample selected is a bone fragment associated with a first-century AD Roman tile kiln from Reigate, currently being reconstructed by WCMS in the Tunnel Road East ‘caves’ at Reigate.

SOURCE: BURGESS, Peter M., 2017, Radio carbon-dating. *News of the Weald* 101, page 2.

World’s largest underwater cave yields sacred Maya relics

The world’s largest underwater cave complex, spanning an incredible 216 miles of subterranean caverns, was discovered in Mexico in January 2018.

When archaeologists unveiled this immense, immersed labyrinth, they said it wasn’t just a natural wonder, but an important archaeological find set to reveal sunken secrets of the ancient Maya civilisation – and already that promise is holding true. Unveiling their preliminary findings in mid-February, a research team from Mexico’s National Institute of Anthropology and History said the sprawling cave consists of almost 250 *cenotes* (naturally occurring sinkholes) and hosts 198 archaeological sites, some 140 of which are Maya in origin. This undoubtedly makes it the most important submerged archaeological site in the world. Another important feature is the amount of archaeological elements that are there and the level of preservation they contain.

Among the finds the divers have already uncovered are human remains, including skeletons and seemingly burnt human bones, that are at least 9,000 years old – suggesting human activity in the eastern Mexican region goes back thousands of years earlier than researchers thought, possibly as part of an ancient Maya trade route. Inside the cave, researchers found fossils of numerous creatures from the last Ice Age, including giant sloths and bears, as well as the remains of an extinct elephant-like animal called a gomphothere.



NEWS – CONSERVATION AND HERITAGE

Roman Mithraeum restored at its original site, City of London

Members who visited Rome with Subterranea Britannica recently will recall visiting a temple dedicated to Mithras below a large modern warehouse. Another such temple dating from the 3rd century AD aroused massive public interest when it came to light in London in 1954 during excavations for the foundations of Bucklersbury House in Walbrook, which has now been demolished.

It was thought at the time that preservation *in situ* would be prohibitively expensive, so the walls were relocated 100 metres away to a site in Queen Victoria Street, where they have for over sixty years been exposed to public view, and to the weather, provided with a far from 'Roman style' floor of modern 'crazy paving': the temple had probably had a bare earthen floor below timber which has not survived.

The original location, alongside one of London's lost (culverted) rivers, the Walbrook, with waterlogged sediments was highly conducive to the preservation of materials generally liable not to survive burial. Finds of contemporaneous artefacts disappeared into what is now the Museum of London.



The temple has now been restored to very nearly its original location, now within a purpose-built publicly accessible gallery seven metres below street level in the basement of the new European HQ of Bloomberg. The original earthen floor as found in 1954 has been replicated with durable material created from Roman soil, and over 600 of the finds from the site, some of them newly excavated, are now displayed. During the latest phase of building at this location, important new structures and artefacts have come to light, including a number of Roman writing tablets on one of which the earliest recorded written name of our capital city, Londinium, is preserved.

There is no charge for entry to the relocated Mithraeum, but in view of the expected level of public interest a pre-booked timed entry 'slot' is advised, via www.londonmithraeum.com.



There is some concern that the archaeological site is already imperiled by human activity – both from tourists who enter the *cenotes* to snorkel and swim, and also pollution: a major highway runs over much of the cave, which is also close to an open-air dump.

SOURCE: *Science Alert*, 21 February 2018.

Bronze Age finds and Pictish engravings at Moray, Scotland

The Sculptor's Cave, on the Moray coast, is accessible only at low tide, but has long been recognised as rich in archaeological finds including Bronze Age bracelets and pottery, human bones and Pictish carvings on the walls. Archaeologists from the University of Bradford have been working on the production of a 'high resolution animated model' of the cave, making its internal details and the carvings much more readily accessible. Through laser scanning (structured light scanning) the details have been digitally preserved, allowing them to be studied at leisure with no need to worry about the tides or the weather. Online access to the 'walk-through' production, and a display at the museum at Elgin are planned.



More information can be found at www.elginmuseum.org.uk, and a video of the 3D animation can be found on YouTube at <http://bit.ly/2kgtVaG>. A monograph by Professor Ian Armit and Dr Lindsey Büster on the cave excavations is to be published shortly by the Society of Antiquaries of Scotland.

SOURCE: ARMIT, Ian, and Lindsey BÜSTER, 2017, Digital exploration of the Sculptor's Cave. *Current Archaeology* 28 (10) (334) (for January 2018), page 13.



On one Sunday in 1954, reportedly, 30,000 people queued to visit the discovery site, and a further 5,000 had to be turned away.

The treatment of archaeological finds of this level of importance in 1954 was far less satisfactory than it is today. Then, investigation depended entirely on the goodwill of site developers. Time is money, and it was a matter of luck whether or not archaeologists were allowed access which delayed work. It was suspected that some developers might quietly destroy any finds which appeared to be of major importance, to avoid interruptions to their building programmes.

Today, developers are required to engage and pay professional archaeologists to prepare desk studies, conduct site investigations or excavations, and maintain 'watching briefs' at work in progress. Most such work is now carried out by commercial archaeological site-investigation companies, and results in published reports, at least in the 'grey literature' category.

SOURCES: FOWLER, Louise, 2017, Mithras reborn: London Mithraeum. *British Archaeology* 158 (for January 2018), 30–35 and 37, and JACKSON, Sophie, 2017, London Mithraeum: reimagining the famous Roman temple. *Current Archaeology* 28 (10) (334) (for January 2018), 18–24 (published December 2017).

Future of Scott's Grotto is secured, Hertfordshire

Following months of discussions with the Ware Society, East Herts Council has decided to secure the future of Scott's Grotto in Scotts Road, Ware by setting up an independent charitable organisation to own and manage it. The Grade I listed Grotto was built in the 18th century by John Scott, a poet, and has a fascinating series of interconnected chambers extending some 67ft into the chalk hillside, lined with shells, flints and pieces of coloured glass as well as a summerhouse above the tunnels.

This decision offers many advantages for Scott's Grotto including the opportunity for increased community involvement in its local heritage as well as opening up possibilities for new uses to attract more visitors. As a charitable organisation the grotto will also be eligible to apply for development grants.



Several theories exist as to why Scott built it: was it that he just wanted to decorate his garden or perhaps he wanted somewhere to write? Another possibility is that he needed an attraction to draw London society out to visit him in Ware. John Scott kept a visitors' book which contains three thousand names so the attraction obviously worked.

Scott's Grotto is open to visitors from 2pm to 4.30pm each Saturday and bank holiday Monday between April and September.

Further information at www.scotts-grotto.org

SOURCE: East Herts Council website.

Fort Luton in Chatham reopens to the public

In 1859 Lord Palmerston instigated the Royal Commission on the Defence of the United Kingdom to review the nation's defences. At the time there was a strong possibility of a French attack and the country's existing defences were deemed obsolete.

The report was published the following year with the recommendation of the construction of a series of forts to strengthen the defences around the country against landward attack. Over 80 forts were built with five being constructed in Medway to protect the Royal Dockyard, Royal Arsenal and the approach to London. Fort Luton was the smallest of the 'Chatham Concrete Ring'; the five were Fort Borstal, Fort Bridgewoods, Fort Horsted, Fort Luton and Fort Darland.

The fort stayed in the Ministry of Defence's hands, and reports suggest that the site was used as a summer camp for the Territorial Units and the Army Cadet Force, but in the late 1950s the land around the fort and the fort itself were sold to Kent County Council for £1 to enable a new secondary school to be built, on land immediately to the north of the fort. The school did not find a permanent use for the fort and it remained derelict.



In March 1988 Kent County Council sold the fort at auction. The new owner had hoped to develop the site but due to the fort's having listed status, planning permission was rejected and the fort was sold again at auction in 1990. The new owner converted the fort into a tourist attraction and model museum; the museum's attractions included



a model railway, model workshop, model village and fairground, bygone tools, Victorian themes areas, as well as an adventure playground, tea rooms, a duck pond and shop. Fort Luton has been under new ownership since 2012. Whilst being shown around, the new owner was disappointed to learn that the fort had fallen out of use and was no longer open to view by anyone; with this in mind he offered to buy the fort so that he could find a way to put it back into use. Various options were considered and after three years it was decided that it should become a Community Interest Company with long-term hirings of the casemates and some land to provide long-term revenue for the fort's upkeep, with short-term hirings to allow the local community to access and enjoy the fort with new and interesting events.

Following completion of the restoration work, much of which was done by volunteers, Fort Luton reopened to the public with a WWI event during the Easter Weekend 2018.

Further details about when the fort is open can be found on the fort's website: <http://fortluton.co.uk/index.html>

SOURCE: Fort Luton website

New approach to the protection of field evidence for historic mining

The archaeological term 'bell pits' generally refers to closed circular depressions assumed to represent the shaft tops of small-scale mines for minerals such as chalk, coal or ironstone at various places throughout the UK. As few have been excavated in depth, it is often a matter of conjecture that these shafts widen at the bottom where the sought mineral stratum was exploited, giving rise to the name.

Bell pits commonly occur in clusters, and there is some resistance on the part of landowners to Scheduling groups of them as Ancient Monuments, with implications for land use. A recently published letter suggests that as mine shafts throughout Europe commonly had trees planted at them to warn of hazardous ground, some ironstone pit shafts at Emley near Wakefield could be safeguarded from landowners' or occupiers' bulldozers by placing tree preservation orders on such trees.

SOURCE: FAULL, Margaret L., 2017, Saving trees – and bell pits. *Current Archaeology* 28 (10) (334) (for January 2018), page 6.

Cold War Borough Control reopens to the public

On Saturday 17 March 2018 Gravesend's Borough Control bunker in Woodlands Park in Wrotham Road was officially reopened by the Mayor of Gravesham, Cllr Harold Craske.

The bunker was an underground control centre, built in 1954 as part of Civil Defence Region 6. Gravesend's rescue and emergency services were to be co-ordinated from the bunker in the event of a nuclear attack. Its thirteen rooms contained power and ventilation plant, communications areas for the command staff and various dormitories.



The signals room

Refurbished and re-equipped to look as it was in the 1950s, the bunker gives the visitor the chance to experience its atmosphere and glimpse into Cold War-era Britain. Exhibits include a domestic fallout room, communications room and a replica ROC monitoring post. Visitors also have the opportunity to view a government film advising the population on how to protect against a nuclear attack.

The bunker is now the proud new home to a WE177 air-dropped nuclear bomb, once part of Britain's nuclear arsenal against the threat posed by the Soviet Union during the Cold War. The WE177 'family' were variable-yield nuclear weapons and all could operate in various ways, from parachute-retarded or free-fall, air burst, ground burst or a burst in water. This type of bomb was introduced into service in the Royal Air Force in the 1960s, and succeeded earlier types of air-dropped nuclear weapons.

The bunker made its screen debut in May 2010 in a film called *Age of Heroes*. Its various rooms and main corridor were used to represent the Cabinet War Rooms in London's Whitehall. The film starred Sean Bean and James D'Arcy and was released in June 2011.

The bunker is owned by Gravesham Borough Council and operated by Thames Defence Heritage. The bunker museum is open Thursday to Saturday 9am–5pm, Sunday 10am–4pm. Further information at www.visitgravesend.co.uk/event/cold-war-bunker-tours

SOURCE: Discover Gravesham website.

NEWS – HEALTH AND SAFETY

Worrying unexplained carbon monoxide in a mine shaft, Derbyshire

In May 2017 members of the Derbyshire Cave Rescue Organisation were called out by a farmer near Matlock Bath to investigate the loss of a pregnant cow which it was thought had possibly fallen down a mine shaft. Cave Rescue Organisation groups frequently receive requests to locate lost dogs and farm animals: it isn't only about human casualties underground.

Air in the suspected shaft was tested with meters able to record low oxygen concentrations and the presence

of carbon dioxide CO₂, carbon monoxide CO, hydrogen sulphide H₂S, and methane CH₄. Several different meters sounded alarms at a depth of about 20 metres, and recorded lethal levels of carbon monoxide.

This extremely toxic gas was not expected, and if encountered by human beings is especially dangerous in being odourless, and having no readily detectable warning signs. Those killed by it simply feel drowsy and die painlessly. It was once, of course, a favourite means of committing suicide by town gas, when one of the principal components of the gas was CO. Sticking your head in a gas oven and turning the gas on no longer works by CO poisoning, although the CH₄ content of town gas could result in a spectacular explosion if ignited.

Carbon monoxide is not usually expected underground. It can result from partial combustion of coal or gas, organic materials such as wood or plastic or rubber, or the detonation of explosives. The dead cow was found, and presumably was put out of its misery in its last breaths by carbon monoxide blocking oxygen transport by its blood supply.

Members are reminded that exploring little-frequented and/or usually sealed shafts and underground voids should not be done without checking the breathability of the air in them. The source of the CO in this shaft near Matlock Bath remains a mystery.

SOURCE: BRETNALL, Alan, 2017, High carbon monoxide. *Descent* 259, page 11.

NEWS – MILITARY AND DEFENCE

RSG 4 bunker in Cambridge gets a new use

In the early years of the Cold War, if the Russians dropped bombs on Cambridge – a strategic target, considering the twenty-six Royal Air Force bases in Cambridgeshire – over three hundred local government workers were to make their way to a two-story multi-winged 3000-square-ft bunker on Gilpin Road. There they would remain indefinitely.

Scientists, firemen, police officers, civil defence staff, the ministry of health, ministry of agriculture and fisheries, ministry of labour, ministry of transport, treasurers, illustrators and stenographers would rush in and settle down and continue the work of running the county, safe behind 1.5-metre-thick concrete walls.

The bunker was Grade II listed by English Heritage in July 2003. Cambridge University bought the building in 2008 with the intention of converting it into a storage space. Initially the building was left empty as the University still had sufficient space but work is to start in the next few months to renovate the building for its new role. It is hoped that many of the original internal features can be retained while making the building suitable for its new use. The university have not said what they intend to store in it.

Built between 1953 and 1955 as Regional War Room 4 and extended in the 1960s as RSG4, the bunker was part



The main entrance to the bunker in 2001. Photo Nick Catford of a government office complex along a tributary of the River Cam, off Brookland Avenue. The building was in operation through the First Gulf War, when it served as a communications centre, until it was declared outdated in the late nineties. Private contractors bought the strip of land, erecting rows of modern apartments with big windows and stone walls. Of the original complex, only the bunker remains. It has stood undisturbed since the contractors used it as their site offices.

SOURCE: *Varsity*, 8 March 2018.

[The bunker was visited by members of Sub Brit in March 2001. Cambridge University approved another visit which took place on 13 April 2018; a report of this visit will be published in *Subterranea* 48.]

Hopton R2 ROTOR site sold to Potters Resort

The Hopton ROTOR radar station in Suffolk been sold to its next door neighbour Potters Resort (holiday centre), who have also bought the land on the other north side of their property. Potters have no plans for development of the site and have only bought the land to prevent anyone else developing it.

Hopton ROTOR came on line in 1953 but with the coming of the H bomb in 1955 and the arrival of high speed bombers, 'RAF Hopton' was deemed redundant before the end of the decade. By 1970 the site had been sold to a local farmer but during the next 15 years it remained derelict and a regular haunt for local vandals and Hell's Angels. By 1984 the entrance guardhouse was little more than a shell and eventually, after the death of one of the Hell's Angels, access to the bunker was sealed with concrete.

In 1988 a large plot of farmland which included the former ROTOR station was compulsorily purchased by the Ministry of Defence as it was required as a Ready Platform for the UKADGE Series II Radar System controlled from RAF Neatishead. The new radar was sited on top of the bunker.

RAF Hopton remained operational until April 1997 and remained in MOD hands until January 2000 when the 11





The excavated stairwell seen during the Sub Brit visit in July 2002. Photo Nick Catford

acre site was sold to a private purchaser who renovated the prefabricated accommodation block and turned it into a private house. The new owner was keen to discover more about the history of the site and reopened the bunker by digging out the rubble from the old guardhouse which had been dumped into the stairwell and covered over. The site, which includes the bunker and an ROC post, was visited by members of Sub Brit in July 2002.

There is no longer anyone living on the radar site, but its new status should ensure it is protected from development, which is rife in the area.

SOURCE: Paul Johnson & Sub Brit website.

Lift shaft and historic machinery at the Needles Battery, Isle of Wight

The Needles Battery, on the chalky westernmost point of the Isle of Wight, was constructed in the 1860s as part of a scheme to defend the sea approaches to Portsmouth and Southampton. It was equipped with guns at the cliff-top level, but advances in potential enemy firepower resulted in the battery being modified in the 1880s to include larger guns at sea level.



Surviving equipment in the lower level

Access via the sea or down the cliff face being impracticable, a 200ft lift shaft was sunk through the chalk, with five low-level tunnels at the bottom connecting to the new gun positions and a searchlight, all in the north-facing cliff. The searchlight was still operable in the Second World War, and the shaft also served as a route for a pumped water supply for surface installations. No longer in military use, the site was acquired by the National Trust in 1976, and Scheduled as an Ancient Monument in 1979.

In-situ engines, generating sets and a water tank were recorded during a recent visit. The survival of machinery representing a century of engineering evolution associated with the structures they served justified the Scheduling. Access difficulties and health and safety issues, and a lack of funds to mitigate them, mean that arranging a repeat visit is unlikely.

Plans to restore Beacon Hill Fort as a tourist attraction, Essex

Two friends have bought the overgrown Beacon Hill Fort in Harwich, Essex. They hope the abandoned fort spread across five acres will help boost jobs and attract tourists to struggling Harwich. Although it is now being reclaimed by nature, Beacon Hill Fort's guns once guarded Britain through two World Wars and was developed in King Henry VIII's reign when it awaited a German invasion that never came.

The development plans came after it was revealed a radar tower in the town was Britain's least visited attraction – with just six sightseers coming in 2013. The imposing batteries, radar posts and observation points loom over the coastal town on the banks of the Orwell and have been closed since the 1950s. Vandals have sprayed obscene graffiti on its ancient walls, with rubble strewn across the vast weed-infested site. It is hoped the fort will be turned into an activity centre and camp site. The sprawling ancient scheduled monument will need extensive refurbishment if its 25 buildings will be safe for sightseers. Much of the fort was built in the 19th century and was quickly upgraded when war loomed.



The bombproof shelter, the main entrance is to the right and the engine room is to the left. Photo Nick Catford

Friends Barry Sharp and Paul Valentine think that with the right grants they will be able to transform the fort and Harwich's fortunes. Officials have welcomed the plans and say they will work closely with Historic England and the owners to restore it. A spokesman for Tendring Council said: "We are delighted that the new owners are eager to find a way to conserve the Fort and to add to Harwich's fascinating heritage attractions. Early discussions with them have begun to explore ways in which they and the Council can work together."

The new owners of the fort have been in touch with Sub Brit having seen the website and want to keep in contact with the Society in the future. The fort includes a number of underground structures including ammunition magazines and the 33-metre-long vaulted chamber described as a 'bombproof shelter' for the infantry troops defending the Twydall Profile.

SOURCE: *MailOnline*, 24 January 2014.

Rail-mounted heavy guns stored in tunnels in Kent

The idea of mounting big guns on railway vehicles for the defence of the Kent and Sussex coasts was apparently put forward in the 1840s, within five years or so of the opening of the Brighton and South-Eastern Railway companies' first main and branch lines. Mobile rather than fixed location guns would avoid their being vulnerable fixed targets, and rail lines could be kept negotiable more readily than common roads.



A drill session in progress as HMG Boche-Buster waits outside the south portal of Bourne Park tunnel in March 1941.

Photo from Imperial War Museum, reproduced under creative commons licence

There was the problem that the barrel of a big rail-mounted gun could not be aimed at targets other than straight ahead without the likelihood that the vehicle would fall off the track. Curved lengths of track, existing or specially built, allowed for variations of gun orientation to bring a variety of targets beyond the Dover

Strait under fire. However, nothing was done until in 1894 a rail-mounted gun assembled at the Brighton railway works was trialled on lines in Kent and Sussex, but not adopted for service.

In 1941 thirteen batteries of railway gun trains were established. These consisted, additionally to the gun itself, of soldiers' accommodation, wagons for ammunition, stores and tools, and crane wagons for re-railing derailed trains. Lightly used lines, preferably with suitably curved sections, were selected for active service, and modifications needed for access and flexibility made. Some new lengths of curved track were also laid. Tunnels such as those at Bourne Park and Guston were adapted for stabling the trains out of sight when not in active use. Bourne Park (or Bishopstone) tunnel is on the now-closed Elham Valley line in east Kent, whereas Guston tunnel is still in use on the line from Dover to Thanet coast towns via Martin Mill.

SOURCE: GOODWIN, John, 2018, Railway guns for UK coast defence, 1847–1945. *Casemate* 111, 32–33.

Highland Emergency Centre at Raigmore has been sold

Highland Council has accepted an offer for the WWII Sector Operation Centre at Raigmore, Scotland. The subterranean property in Inverness was upgraded in the 1980s during the Cold War. In 1988 the site was acquired by the Highland Council and with a 90 percent Government grant it was converted into their emergency centre, also incorporating the Inverness Borough Emergency Centre.



The Raigmore plotting room during WW2

Highland Council, which still owns the site, put the bunker up for sale last year. An offer for the bunker has been accepted and the sale is currently being finalised. The buyer, however, remains a mystery and the local authority has not revealed the price it went for. It is believed that there were numerous offers for the WWII facility – in Mackintosh Road – that played a crucial part in defending Scotland from German air attack. [The bunker was visited by members of Subterranea Britannica in 2001.]

SOURCE: *BBC News – Scotland*, 20 February 2018.

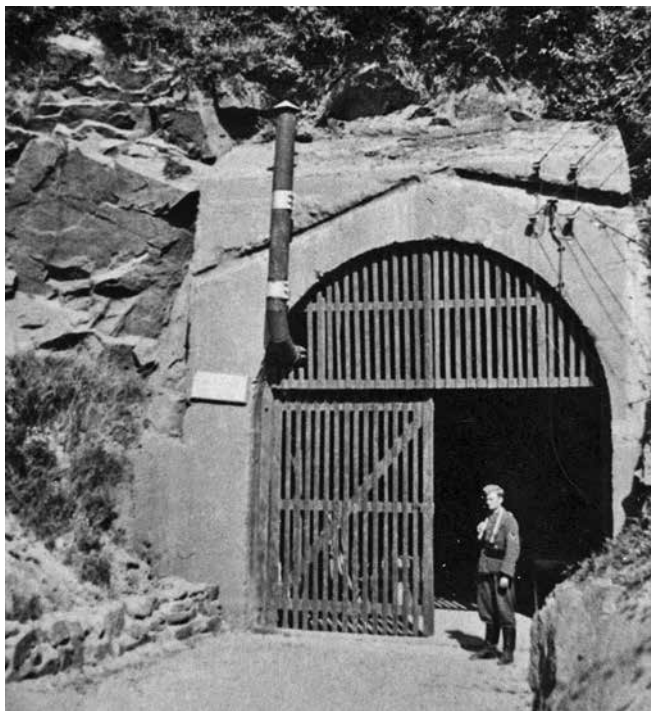


German tunnels on Guernsey for sale

A network of underground tunnels built by the Germans during their invasion of the Channel Islands in World War II has gone up for sale for £150,000. The secret passageways were dug out in 1942 by the Germans who deliberately built under St Saviours church as they believed it was less likely to be bombed. They used the 80ft-deep tunnels mainly to store weapons and ammunition.

Maureen Turnbull has put up for sale the tunnels under her house which were built by the German Army during the Second World War using slave labour from Poland and Russia. After the war the tunnels were left abandoned and forgotten about until they were rediscovered in the early 1980s by chance. Homeowner Derek Turnbull was doing some gardening in the grounds of his large detached home when he found a hole in the ground. He put a ladder down it and was stunned when he found 1,200ft of tunnels.

He and his wife Maureen spent five years clearing them out before opening them as a museum in 1985. The museum did well and remained open for 18 years. It closed in 2002 when Derek died.



The tunnel is part of the tunnel complex known as Hohlgangsanlage (Ho) 12. It runs from one side of the hill to the other, but there was a dispute as to its ownership. The current owner owns the part of the tunnel under her property. The middle section is claimed by the Church as it is under their land although they do not have an entrance or any access rights. The other end of the tunnel is owned by another landowner. There are barriers in the tunnel preventing access to the parts owned by the Church and the other landowner. [The tunnel was visited by a party of Sub Brit members in 2014 – see *Subterranea* 38, April 2105.]

SOURCE: *MailOnline*, 28 December 2017.

Chilmark RGHQ sold

RGHQ 7.1 at Chilmark was sold to Fonthill Estate, Fonthill Bishop, Wilts in November. Fonthill Estate own a number of other sites in Wiltshire that are run by EHD, a bonded wine warehousing and distribution company. RGHQ 7.1 was built in the mid-1980s, to replace the former SRHQ at Ullenwood near Cheltenham. It was closed in about 1992. It came onto the market in March 1997 and was sold to local businessman David Graham who leased it to another local businessman, Martin Fillery in 2013. The bunker was raided by Wiltshire police during the night of 22 February 2017. Fillery was subsequently jailed for eight years. (see *Subterranea* 46, page 41.)



*RGHQ Chilmark in January 2018
after undergrowth clearance*

The bunker has now been cleared of undergrowth ready for its new use.

SOURCE: Ben Marshall

Israel builds an underground barrier across the Gaza Strip

The Israeli army has unveiled details of a massive underground barrier being built along the Gaza Strip to stop militants digging ‘attack’ tunnels. Eventually stretching 41 miles, the concrete wall will be accompanied by motion sensors designed to detect tunnel digging and is expected to be completed by mid-2019.

The project had been previously announced, but details of its construction had been kept secret until now. The details were unveiled days after the army destroyed what it described as a tunnel intended for attacks stretching from the blockaded Palestinian enclave into Israel and eventually Egypt – this is the third tunnel uncovered and demolished in less than three months.

Tunnels were among Hamas’s most effective tools during the 2014 war with Israel, with militants using them to enter the Jewish state, carry out attacks and at times even return to Gaza through the underground passages. Hamas and other militant groups in Gaza say tunnels are needed for defence. An Israeli state inquiry published last year accused Prime Minister Benjamin Netanyahu and top army brass of being unprepared for the ‘strategic



threat' of the tunnels from the enclave run by Islamist movement Hamas. But with the new underground barrier and sensors detecting movement, militant groups would no longer be able to build and use tunnels, a senior Israeli army official said.

Heavy machines will be used to dig a deep, narrow trench, filling it with bentonite slurry that keeps the trench from collapsing. A metal reinforcing cage is inserted, with tubes sucking out the slurry and then filling the trench with cement drying into a wall approximately a metre wide. A new, eight-metre high border fence being erected above the underground wall will further prevent infiltrations of Gazans into Israel.

SOURCE: *MailOnline*, 18 January 2018.

NEWS – MINES AND MINING

Welsh gold mines could reopen

Various news reports have been circulating that gold mining might restart at both Clogau and Gwynfynydd gold mines. Some work appears to have taken place at Gwynfynydd – the construction of a new hydro-electric plant – but apart from some tidying-up work and new fencing around the various openings, nothing appears to have happened at the mine site yet.



Gwynfynydd gold mine in 1994. Photo Gordon Edgar

At the end of 2017, Alba Mineral Resources acquired 49 percent of 'Gold Mines of Wales' with a view to reopening Clogau. It's all very confusing at the moment, as to who owns what. But, it is known that stocks of 'Welsh' gold are running out, so mining will need to start soon.

SOURCE: *Below* – journal of the Shropshire Caving and Mining Club, Spring 2018.

NAMHO 2018 and 2019

The National Association for Mining History field meeting and conference in 2018 will be based at the Dean Field Studies Centre at Parkend (near Lydney) in the Forest of Dean, Gloucestershire. As usual, members of local mining history groups will organise a programme of lectures and surface and subterranean mine sites.

The Forest offers ironstone mines, coal mining sites, at least one underground stone quarry, and at least two abandoned railway tunnels. The conference theme is to be

'Mines, mining and miners of the Forest of Dean: a law unto themselves' and will run from 1st to 3rd June 2018. In 2019 the annual meeting will be based at Llanfagan, Ceredigion, close to mines at Cwmystwyth and Frongoch, a five-day event from 4th to 8th July 2019. Usually those attending these NAMHO events are expected to bring their own tents, or find other accommodation locally.

New railway construction in a salt-mining district, Cheshire

Mining subsidence of any kind is bad news for railways, but arguably the rock-salt mining and brine pumping area of Cheshire is especially problematic. Numerous rock-salt mines have been worked, and that at Winsford is still in production and in modern times very carefully developed. But abandoned rock salt mines have flooded and naturally the incoming ground-water has dissolved more salt, enlarging the cavities and, especially in and around Northwich, causing their collapse.

The problem was, historically, made worse by brine-pumping, the salt-water in the flooded mines being pumped up for salt extraction. Unsurprisingly, more fresh-water took its place, dissolved more solid rock salt, and enlarged the cavities further. The Cheshire landscape is characterised by numerous 'flashes' or areas of now flooded subsided ground. The problems of building a high-speed railway across an area of sometimes poorly documented flooded and progressively collapsing mines are addressed in the cited source.



Winsford rock salt mine

Brine-pumping from abandoned mines has been banned since 1938, and modern controlled brine pumping is managed in such a way that progressive solution and enlargement of cavities is not such a problem, but the historic hazards of course persist. The still worked Winsford mine, operated by Compass Minerals Ltd, consists of pillar-and-stall workings at depths of 140 to 220 metres occupying an area about three by four kilometres.

The 'caverns', which some members may recall visiting with *Subterranea Britannica* some years ago, are up to 20 metres wide and eight metres high, the pillars of *in-situ* rocksalt being generally about 20 metres square. The new HS2 line is due to pass over a 3.1 km length of



mined ground. New rail viaducts in critical areas may be supported on piles up to 120 metres deep to ensure stability. SOURCE: ECCLES, Chris, and Simon FERLEY, 2018, *Geology and HS2. Geoscientist* 28 (1), 10–15.

Scottish gold mine gets planning permission to commence production

Plans for full-scale gold and silver mining at Cononish Gold Mine, near Tyndrum, has been given the backing of the Loch Lomond and the Trossachs National Park Authority. The Cononish mine produced gold for the first time in August 2016 following the launch of an ore processing trial. Its operator, Scotgold Resources, now plans a much larger extraction. A small amount of gold has already been refined and sold – at premium prices. Scotgold Resources now plans to reopen an old mine shaft and remove more than half a million tonnes of mineral ore, along with up to 170,000 tonnes of rock. The final positive decision of the national park’s planning committee was made after a site visit on 27 February. Operations could last up to 17 years. A previous plan limited the operations to ten years, but the firm is leaving open the option of slower production, depending on its finances. The previous plan has also been amended to change the way in which the rock stacks will be distributed, removing the need for diversion of a burn on the site.



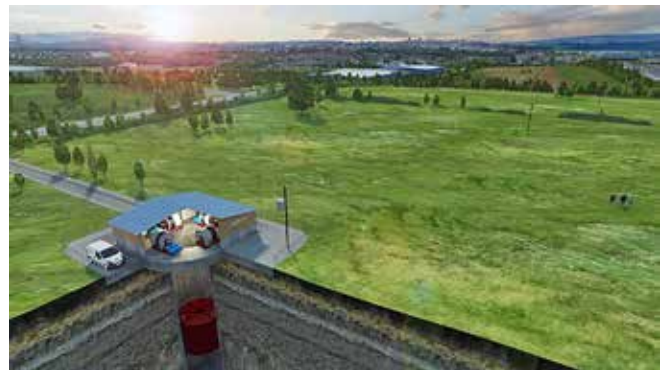
A temporary bridge is being planned to keep site traffic away from the West Highland Way. As many as 52 jobs could be created during production, and the firm has offered nearly £500,000 in payments to support the local community. The local Strathfillan community group was in support of the application.

SOURCE: *Below* – journal of the Shropshire Caving and Mining Club, Spring 2018.

Disused mine shafts could become green energy power stores

Gravitricity has secured a government grant to fund the suspension of massive weights in old pit workings to generate power for the grid. The Edinburgh company believes that it can use gravity and relatively simple engineering mechanisms as an energy store. It is proposing to hang a weight of up to 2,000 tonnes down a mineshaft, held by cables attached to winches on the surface.

When the grid or local wind turbines are producing surplus energy, the weight would be lifted up the shaft; when demand outstrips supply, it would be lowered by gravity, and the resultant movement of the winches would generate electricity.



Artist's impression of a gravity installation

When there is excess electricity, for example on a windy day, the weight is winched to the top of the shaft ready to generate power. It can then be released when required, in less than a second, and the winches become generators, producing either a large burst of electricity quickly, or releasing it more slowly depending on what is needed.

The intermittent nature of some renewable energy generation methods, particularly wind power, means they cannot be relied upon all year round to provide a stable supply of electricity.

SOURCE: *The Times*, 8 February 2018.

NEWS – MISCELLANEOUS

£9m upgrade for Norwegian doomsday vault

The Svalbard Global Seed Vault designed to prepare the human race for oblivion is buried 130 metres inside a mountain on Svalbard in the Arctic Circle between Norway and the North Pole. It boasts five doors with coded locks and combinations known only by a few people. To further ensure security, the vault is unlocked for deposits only three or four times a year.

Norway is now spending 100 million kroner (£9 million) to upgrade the vault after ten years of use. The revamp will cover construction of a new, concrete-built access tunnel, as well as a service building to house emergency power and refrigerating units and other electrical equipment that emits heat through the tunnel.



Entrance to the seed vault



A vital batch of seeds, set to provide a food supply post-apocalyptic war, will also be delivered to the underground concrete bunker. The vault holds nearly a million different varieties of crop seeds including potato, beans, rice and wheat from almost every country around the world. The upgrades will ensure that the Svalbard Global Seed Vault can continue to offer the world's gene banks a secure storage space in the future. [See article in *Subterranea* 29 (April 2012), page 76.]

The Svalbard seedbank was opened in 2008 with the aim of providing a fail-safe seed storage facility, built to stand the test of time and the challenge of natural or man-made disasters. An unexpected thaw of permafrost meant some water flowed into the entrance of the tunnel to the vault in late 2016. In 2015, researchers made a first withdrawal from the vault after Syria's civil war damaged a seed bank near the city of Aleppo.

SOURCE: *Daily Star*, 24 February 2018.

New use for old coal mines, Glasgow

Temperatures below ground increase with depth, as can be observed in descending deep mines, and as also appears to be obvious from volcanoes erupting molten rock from some miles down. Even at quite shallow depths, including for example the deep London tube-train tunnels, it is warmer (at least in winter) than at the surface, although in this instance much of the heat is from the trains, passengers and lighting.

Going down some hundreds of feet one encounters the geothermal gradient unadulterated, so to speak. Some current British Geological Survey research is focused on extracting heat energy from groundwater, which is to say rainfall which has disappeared underground and gained heat from the rocks in which it is held. Members of *Subterranea Britannica* who venture even to shallow depths will know that in snowy weather it is noticeably warmer underground: temperatures in mine and quarry tunnels in east Surrey, for example, are usually at a steady 14° C summer and winter.

Groundwater held in the pores and hairline cracks in, for example, sandstones under the coalmining district around Glasgow do not transmit water very quickly, other than through the wider fissures. But old mine shafts and worked-out seams, whether left open or loosely back-filled with waste rock, are characterised by considerable volumes of interconnected voids through which water can pass much more freely.

Pumping relatively warm water from these reservoirs and pathways promises to be an economic means of tapping this geothermal energy. The current study concerns abandoned seams and shafts at depths of 10 to 200 metres below the river Clyde. Boreholes are planned to be drilled to enable the available geothermal yield to be assessed.

SOURCE: HORTON, Julia, 2017, UK geoenery observatories. Natural Environment Research Council / British Geological Survey: *Planet Earth*, Autumn / Winter 2017, 22–23.

New cave network found under Montreal park, Canada

Pie-XII Park lies in the heart of Montreal, surrounded by busy city streets. But it's what lies beneath those streets that has cave experts and city residents buzzing. A new network of caves, dating back to the Earth's last Ice Age, and extending nearly 700 feet, was discovered in October by Daniel Caron and Luc Le Blanc, two speleologists. The find was only recently announced after the site was secured. On October 12, Caron and Le Blanc were exploring the already well-known St Leonard cave that lies just underneath Pie-XII Park. The original portion of the cave had been discovered in 1812, but cave experts have long speculated that more was hidden beneath. Caron and Le Blanc decided to explore their hunch in 2014, when they began spelunking through the St Leonard caverns searching for new passages.



The farthest reaches of the St Leonard caverns begin to fill with water. Photo Luc Le Blanc

Le Blanc, armed with a new radiolocation kit, and Caron, using a divining rod, were hunting for voids or signs of water lying on the other side of the cave's walls. By 2015 they had found a small, narrow opening in the back of one cave. Using a small camera, fellow speleologist François Gelinas was able to peek through the opening, where they saw a large room just behind the wall.

Although eager to bust through the wall, they weren't able to move past it until nearly two years later. The cave walls in St Leonard are made of solid limestone, and opening a passage required industrial-strength drills. Once they were through, they entered a large room, climbed down a big drop, and entered a tall, narrow hall. The walls are perfectly smooth and the ceiling is perfectly horizontal. They estimate the ceiling to be roughly 20 feet high.

In addition to the smooth limestone walls lining the cave, stalagmites and stalactites were found throughout the passage. So far, Caron and Le Blanc have been able to estimate that the 10 foot-wide passageway extends roughly 700 feet. Water spilling into the farthest reaches of the cave has halted their exploration, but they plan to return in February after the water recedes.

SOURCE: *MailOnline*, 6 December 2017.



Williamson's Tunnels: progress at Edge Hill, Liverpool

The Friends of Williamson's Tunnels have been, since 1996, liaising with property owners and others in exploring and facilitating access to a number of enigmatic underground spaces below buildings or sites of former buildings at Edge Hill, Liverpool. They are not, strictly speaking, tunnels dug specifically to facilitate access from one place to another, but rather random chambers cut into the sandstone rock, and some in fact were excavations once open to the sky but subsequently roofed over.

Some are on several levels below the land surface, and most contain inserted brick arches and other structures. It is known that they were created early in the nineteenth century under the direction of one Joseph Williamson, but for what purpose is not clear, so theories abound.



View from Level 3 at Paddington, looking down into Level 4. Photo Chris Rayner

The Friends have cleared large volumes of domestic refuse and building demolition rubble from the voids, which appear to have been used merely for the disposal of rubbish after Williamson's death. The removed material has yielded much of archaeological interest which throws new light on this period of Liverpool's History. And numerous group visits, including by Subterranea Britannica, have been entertained, as well as very popular public guided tours. See *Subterranea* 44 (April 2017), page 63.

SOURCE: MOORHEAD, Claire, 2017, The Williamson Tunnels, Edge Hill, Liverpool. *Industrial Archaeology News* 183, 12–13.

New cemetery catacombs under construction in Jerusalem

Beneath Jerusalem's main cemetery at Givat Shaul, one of several huge new tunnels disappears into the hillside. Inside the hill, the tunnels branch into a grid of three 'avenues' and seven 'streets'. Looking up from the centre of the grid, an imposing shaft rises dozens of metres to the cemetery garden above.

In places the concrete-lined walls of the cavernous interior are perforated with neat lines of tubular holes. Two metres deep, the holes are burial niches, punched into the limestone and dolomite bedrock with a nine-tonne bore. Soon they will serve as graves in Israel's giant new catacombs.



Entrance to the catacombs

Cremation is uncommon in Israel, and on present estimates Jerusalem alone requires space for 4,400 new graves a year. The underground area set aside for the catacombs project will contain about 22,000 crypts in the first instance, at about four times the density of the cemetery above. When the first phase is complete in 2018, the tunnels will provide 6,000 graves with thousands more to follow. Another burial society has already expressed interest in developing more chambers. SOURCE: *The Guardian*, 1 December 2017.

Water storage cisterns for fire-fighting, San Francisco, USA

San Francisco has been devastated by earthquakes and fires from time to time since the 'Great Fire' of 1849. An earthquake on 18 April 1906 (the sixth in 18 months) was followed by a disastrous fire resulting from fractured gas mains. Some 25,000 buildings were destroyed, and an estimated three thousand people died. Over 300 water mains were broken, and 23,000 water services severed. As a result of a recommendation in 1908 a dedicated water supply system solely for fire-fighting purposes was constructed between 1909 and 1913 and has been extended from time to time since. This delivers water at high pressures and is completely independent of the ordinary water supply mains. Water for this system comes from the Hetch Hetchy Reservoir some 167 miles to the east of the city. Currently there are approaching 200 sub-surface cisterns holding from 9,000 to 243,000 gallons of water each. The cisterns are mostly located at street intersections, and their locations indicated by large painted circles on the road surfaces.

SOURCE: LEVITT, Alan M., 2017, San Francisco's cisterns ... the low-tech nearly-unseen infrastructure that San Francisco depends on to fight major fires. *Newcomen Links* [Newcomen Society for the Study of the History of Engineering and Technology] 244, 10–12.

Disused coal mine in China to be used for an underground ski tunnel

In an announcement that encapsulates Beijing's shift away from coal-burning and its zeal for winter sports, a former coal mine in the city will be converted into an Olympic-standard skiing facility that will open by the end of the year.



After it ceases operations at the end of the month, the Muchengjian Colliery will be repurposed into a winter-sports facility for professional and recreational skiers. The conversion will include altering a 1.25 kilometre-long coal mine tunnel into an air-conditioned ski course for cross-country skiing; the trail will feature an 18-meter drop and will be open 365 days a year. The converted mine will also host a network of ski trails on the slopes above it, in addition to a ski-jump training facility.

The world's first indoor ski tunnel opened in 1997 in Vuokatti, Finland (see photo). The 1,210-metre-long tunnel is equipped with snow-making machines along its route that help maintain temperatures of -9 degrees Celsius. Other year-round indoor ski facilities include the world's longest indoor ski tunnel in Torsby, Sweden, as well as the nearly 2-kilometre-long facility in Oberhof, Germany.



The ski tunnel in Finland

Once one of the six major mines that supplied Beijing with coal, Muchengjian is also part of a winter-sports park that is scheduled to host snowboarding events for the upcoming 2022 Winter Olympic Games, for which the majority of facilities have already been built, aside from new developments like the speed-skating arena.

SOURCE: *The Beijinger*, 30 January 2018.

The Newcomen Society and nuclear energy

The Newcomen Society for the Study of the History of Engineering and Technology was founded in or about 1924 and at first dealt largely with mechanical engineering, specifically as the name suggests, stationary steam engines. The Society now includes modern developments in its interests, from engines of all kinds to electronics and civil and military aspects of the applications of nuclear energy. Like *Subterranea Britannica*, it organises lecture programmes, publishes a journal, and arranges visits to both operating and defunct engineering sites.

In view of many SB members' interests in Cold War matters, and in nuclear installations such as Chernobyl, reports of some of the Newcomen Society's visits such as those cited may well be of interest, although lacking subterranean features.

SOURCE: ANDERSON, Guy, 2017, *The Suffolk Coast: Sizewell B. Newcomen Links* [Newcomen Society for the

Study of the History of Engineering and Technology] 244, 18–20; and AYLEN, Jonathan, 2017, *The Suffolk Coast: Orford Ness & Sizewell B. Newcomen Links* 244, 14–17. [Orford Ness was home to the former Atomic Weapons Research Establishment weapons testing site, closed in 1971. The landscape is 'punctuated by futuristic concrete structures built as testing laboratories' and was the location where the casing for Britain's first atomic bomb was tested by being dropped from a Lincoln bomber. There were never any radioactive materials at the site, which is now a Site of Special Scientific Interest on account of resident wildlife, and managed by the National Trust. The Sizewell B nuclear power station has a visitor centre and offers guided tours free of charge.]

Tunisia's underground houses are in decline

In the arid valleys of southern Tunisia's Djebel Dahar region, people have lived for centuries in underground houses whose earthen casing provides protection against searing summer heat and winter winds. But in recent decades, rural depopulation has meant fewer people live in the homes, which are composed of rooms hewn into the walls of an excavated circular courtyard.

The few remaining families say they are attached to the homes and the land or see no way of moving. The homes are concentrated around Matmata, which lies in a cratered landscape dotted with palm trees and olive groves about 227 miles south of Tunis. They are highly unusual, though similar constructions are found across the border in Libya, to the southeast. In other parts of the Djebel Dahar, houses and storerooms were carved from rock and earth above ground.



Many families left the underground houses when new towns and villages were built in the 1960s and 1970s as part of a modernisation drive by President Habib Bourguiba. Locals suspect President Bourguiba wanted to dilute Berber communities as he strove to integrate them into the Arab nation after independence from France. Disputes over inheritance and periods of drought or heavy rain, which can cause the houses to collapse, also contributed to the rural exodus. Some built modern houses on adjoining land, using the traditional homes as stables or workshops.

SOURCE: *MailOnline*, 23 February 2018.



Plan to install fibre-optic cables in sewers to prevent fatbergs

Nuron is developing a fibre-optic sewage system with Sheffield University. The cables would let companies monitor the flow of sewage pipes in real-time which would allow them to act before build-ups become blockages in sewers. Cables could also provide high-speed internet without needing to dig up road. Fibre-optic cables can transfer signals over large distances, which is also why they are used for communications systems such as broadband. Wastewater companies could use them to record information about conditions in sewage pipes deep underground.



To be able to perform analytics on a sewer network you need data on what's going on. You need to know about changes in flow depth and rate, as well as temperature. Optical fibre is an ideal sensor for this purpose. Currently, water companies don't have this type of data available, but a system that could enable the monitoring of sewage systems could help prevent fatbergs and blockages. Last year, engineers worked to clean out Britain's biggest-ever fat blockage, which was 250 yards long and uncovered in sewers under Whitechapel.

Underground power station in the City of London

Deep beneath central London, a hi-tech power plant in a former meat warehouse is helping drive down the environmental impact of London's growing energy addiction.

Four storeys down, the £26 million E.ON plant generates enough electricity annually to boil two billion cups of tea, enough cold water to run 42,000 fridges, and enough hot water to fill 70 million baths. The site – below the Port of London Authority building in Charterhouse Street – produces power for 11,300 homes and provides heat to 17 commercial buildings in the Square Mile through a network of tunnels.

It is unique because electricity created by gas turbines generates heat as a by-product instead of it needing to be created separately. The site also creates chilled water for air conditioning. In the basement, water is heated to over 100C, while on the roof huge chiller units cool it down.

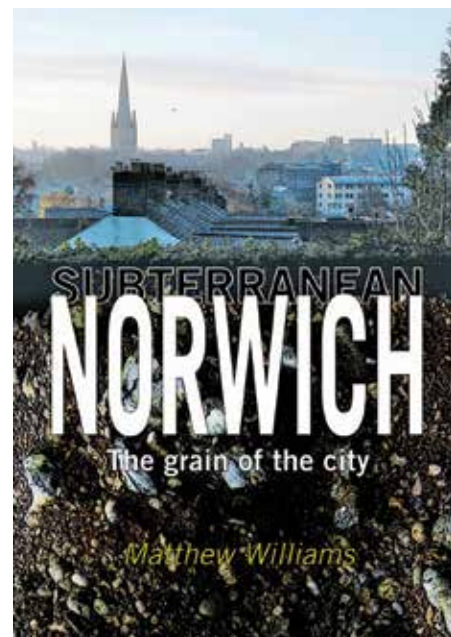


The turbine hall. Photo Martin Godwin

The bunker was originally used for storing meat at Smithfield Market. In the Eighties it was fitted out with two coal-powered 350-tonne ship diesel engines. Later it was refurbished by E.ON, which installed two 8.6-megawatt, 53-tonne higher-efficiency gas-powered generators. These are so large that the equipment had to be brought down in pieces and reassembled underground. The refurbishment was completed in 2016.

SOURCE: *Evening Standard*, 23 March 2018.

NEWS – PUBLICATIONS



Chalk mines and other underground features at Norwich

At least since 3 March 1988 it has been widely known that there have been subsidence problems, mostly but not exclusively related to chalk mining, at Norwich. Almost anywhere on the very extensive Chalk outcrop at least in southern England the presence of adit or shaft mines is a possibility. In the harder chalk of East Yorkshire and Northern Ireland this may not be so much of a problem. The event in question was a double-deck bus falling rear-end first into a subsidence in Earlham Road in the city. Photographs of the bus have been very widely circulated. In 1991 Arup Geotechnics published a Case Study Report on *Norwich Chalk and Flint Mines (Norfolk)* as a small



part of a wide-ranging report for the Department of the Environment entitled *Review of Mining Instability in Great Britain*. In an earlier incident in May 1936 part of a house collapsed into a void resulting in the deaths of two inhabitants whose bodies were recovered from a depth of 12 metres five days later.

Matthew Williams, a chartered geologist, has produced a most useful extended account of the Norwich chalk mines which reviews their history and explains their distribution in relation to the City's geology, topography and water-table. Most if not all of the known mine sites are drift mines which had walk-in level access from the hill slopes, rather than shaft mines, and most tunnelling into the hillsides was limited to relatively short distances of tens of metres.

About ten mining locations have been identified, and it has been possible to piece together partial plans of underground workings. There is evidently very little access to most of the mines, the preservation of which is generally very poor. The city is far from being 'riddled' with tunnels, and the areas at risk of subsidence are quite limited.

Subsidence on the Chalk outcrop is not entirely a matter of mine collapses. Other causes include sewer collapses, water main leaks, and natural solution processes in which percolating rainwater dissolves the chalk.

This book is, therefore, far from a 'coffee-table' book of photographs of underground landscapes, and Norwich seems unlikely to feature amongst our Society's visits programme. There is a good index and a useful 'further reading' list of publications dating from 1881 to 2015.

WILLIAMS, Matthew, 2017, *Subterranean Norwich: the grain of a city*. Norwich: Lasse Press: xvi + 160pp [ISBN 9780-9933069-6-9]. For an extended review of this book, see: CATLING, Chris, 2017, Ground underfoot: delving into the secrets of underground Norwich. *Current Archaeology* 28 (10) (334) (for January 2018), 32–41.

Royal Observer Corps: The Eyes and Ears of the RAF in WWII – Official History

Frontline Books, 26 February 2018

The key roles played by the Royal Observer Corps in the Second World War have, all too often, been overshadowed by more glamorous arms of the defence forces. The teams in the Sector Stations, plotting the battles raging above, and the Spitfires and Hurricanes swooping upon the formations of enemy fighters and bombers, present easily-imagined and dramatic scenes. Yet between the radar stations, detecting the German aircraft approaching over the Channel, and the Sector Controls were the little sand-bagged posts of the Observer Corps that provided over-land tracking of the enemy formations.

The Royal Observer Corps (the Royal prefix being approved in 1941) proved a vital link in the communication chain in the defence of the UK, particularly in the Battle of Britain, as it provided the only means of tracking enemy aircraft once they had crossed the coastline. The

highly-skilled Observers were also able to identify and count the enemy aircraft, turning blips on a screen into actual types and numbers of German machines.

Even after the threat from the Luftwaffe receded after the Battle of Britain and the Blitz, the ROC again came to the fore when the V-1s opened a new reign of terror in 1944. Because these small, fast weapons were so hard to detect, the RAF's fighter controllers moved into the ROC's operations rooms so that they could respond to the V-1 threat more rapidly.

In this official history of the ROC written shortly after the war, the Corps operations throughout the conflict are set out in great detail. This includes a section on the last flight of Rudolf Hess, as well as one detailing the work of those who were selected for employment as Seaborne Observers on ships during the D-Day landings, where their specialist identification skills were used to prevent the all-too prevalent instances of friendly fire.

This history provides an account of the ROC which is just as important in understanding the operations of the corps as the Observers were in the defence of the United Kingdom during WWII. This is not a new book but a reprint of a book first published just after the war. The book has no named author and no photographs.

Archaeology of Darkness

DETAILS: ORBONS, P. J., 2017, *An archaeology of the darkness: man-made underground structures in the Mergelland region as a source of underground studies*. University of Amsterdam MA Thesis, 12 June 2017: 114pp.

Sub Brit member Joep Orbons is a professional archaeologist whose company ArcheoPro conducts site investigations largely based on geophysical techniques. Whilst many of the sites investigated and reported on by ArcheoPro are surface sites, Joep's underground enthusiasm developed from his childhood in the hilly southernmost part of the Netherlands in and around Maastricht, where he explored some of the numerous underground building-stone quarries and visited his father and others in the examination of the Neolithic flint mines at Rijkholt.

In 1982, with his father, he assisted with subterranean archaeological excavation at the flint mines at Harrow Hill, near Worthing in West Sussex. His enthusiasm for underground places has continued into the 21st century, and he has been a leading member of Studiegroep Onderaardse Kalksteengroeve actively engaged in the study and surveying of the underground quarries in Zuid Limburg and in adjoining areas in Belgium. He has also visited a great many important sites in the UK and in mainland Europe, often in the company of your scribe.

Joep's MA thesis, now published, presents a comprehensive overview of the entire range of man-made underground sites in Mergelland, a local term for the outcrop of the Upper Cretaceous Maastrichtian Limestone called Mergel locally. Detailed surveying using GIS technology



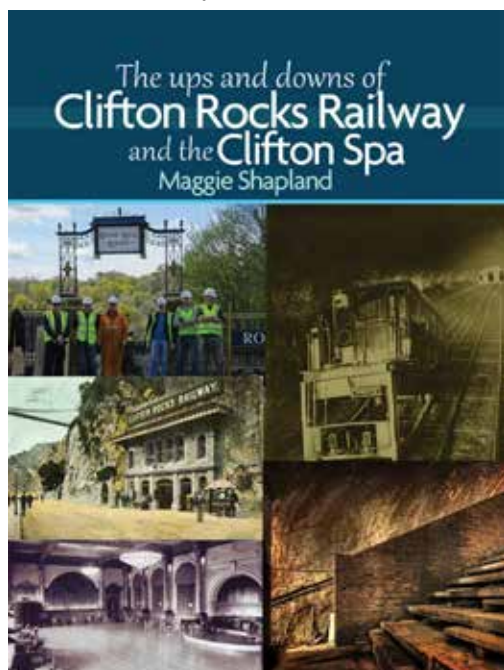
has been an important component of his underground work, and he is currently working in collaboration with the Municipality of Valkenburg where he is monitoring the very extensive Gemeentegrot (underground municipal quarry) and with the official Dutch forestry authority in connection with the Rijkholt flint mines.

Additionally to the mines and quarries his thesis deals also with most of the other man-made underground sites in the region, such as a very few railway tunnels, canal construction tunnels, a small number of purpose-made subterranean air-raid shelters, and some planned but not completed road tunnels. The abandoned deep coal mines and a few small metalliferous mines are not included. Many of the sites have had a range of secondary uses such as mushroom farms, refuges, Cold War bunkers, and several are now tourist attractions.

This most useful overview of the region, in near faultless English, is well illustrated, and includes a number of sites so far unknown to your scribe, despite his numerous visits during the last 40 years or so.

PWS. A very limited number of printed copies have been published, but an electronic copy can be obtained from the author at j.orbons@archeopro.nl

Clifton Rocks Railway, Bristol



DETAILS: Shapland, Maggie, *The Ups and Downs of Clifton Rocks Railway and the Clifton Spa: the definitive history*. £15. Published by Bristol Industrial Archaeological Society (BIAS). Hardback 317 pages including 430 images, many in colour. Foreword by Sir George White. All proceeds from the sale of the book go to the Clifton Rocks Railway Trust.

Delving into the history of this unusual underground cliff railway over the last 12 years has led to unexpected discoveries and research. It is a story spread over 530 years, which befits such a large site. Maggie has told the story interspersed with oral histories, research, quotes

from contemporary newspapers, and artefacts that the volunteers have found during their work since 2005. Images are used to good effect in every chapter, many historic, many not seen before. There's a useful glossary and index.

The story starts in the 1690s with the spa in Hotwells and its demise in 1867. The Sion spring in Clifton was bored in 1796, feeding the smaller baths in Clifton until 1877. Trade in Clifton declined and it was thought that reviving the spa industry would help. Independently, others wanted a lift to be built by the suspension bridge to get visitors up from Hotwells on the River Avon where paddle-steamers docked and a train ran to Avonmouth.

Permission was given in 1891 to publisher George Newnes (who had just built the Lynton and Lynmouth water-powered lift), provided he built a pump room, to enjoy the spring waters, in a tunnel to avoid spoiling the beauty of the Avon Gorge, and did not apply for an alcohol licence. In the end, the railway was opened in 1893, the pump room in 1894, and the hotel and Turkish baths in 1898.

Despite a huge amount of money spent on the project, the railway went bankrupt in 1908, and the pump room turned into a cinema in 1920. Sir George White bought the Railway in 1912 and operated it until 1934 when it went bankrupt again. The problems of building a tunnel in rock on a steep slope, together with operation and maintenance have been included.

The second story starts when WWII broke out and the Spa hotel complex was requisitioned in 1939 by the Barrage Balloon headquarters who also used space in the railway tunnel for offices and a shelter. The rest of the tunnel became an air-raid shelter for Clifton and Hotwells residents, and housed the main BBC control room and transmitting station for the area. The BBC vacated the premises in 1960 since they needed to transmit the Third programme after the war using the equipment in the tunnel. Each of these operations is described and oral histories bring the story to life.

The third story starts in 2005 when after years of dereliction, a band of volunteers got together and started restoration and preservation of the tunnel. The highlights of their work are shown.

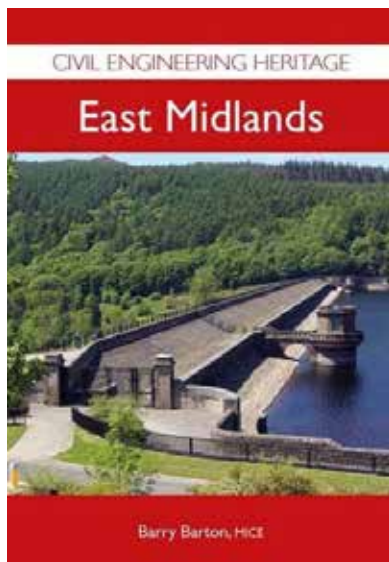
It is not just a cliff railway in a tunnel, it is a tunnel that has had two distinct roles to play, courted controversy when it was suggested that a lift should be built in the 1880s and even now courts controversy as to whether it should run as a railway again, despite going bankrupt twice and having wartime conversions built on top of the tracks. The last chapter deals with this issue.

Maggie is the Restoration Officer, Vice-chairman and Archivist of the railway. A party from Sub Brit visited the railway during the Bristol study weekend in 2006 – see *Subterranea* 12 (December 2006), page 27.

www.cliftonrocksrailway.org.uk



East Midlands tunnels



DETAILS: BARTON, Barry, 2016, *Civil engineering heritage: East Midlands*. Lincoln: Ruddocks Publishing Ltd: vii + 142pp [ISBN 9780-904327-24-3] £17.95.

Civil engineering is concerned primarily with large static structures for civilian, as distinct from military, purposes. The construction of these demands an understanding of the properties of materials such as density, compressive and tensile strength, flexibility, and forces. That means, generally, that civil engineers design bridges, tunnels, and other transport infrastructure, water management structures such as dams, reservoirs, and land drainage, and structures for public utilities such as electricity and water supply.

Chemical, electrical, electronic, mechanical and structural engineers, and others, also have essential roles in many of these things. Military engineering and mining engineering are not generally regarded as coming within the civil engineer's realm. This survey of the civil engineering heritage of the East Midlands, therefore, has nothing to say about defence works, Cold War bunkers and the like; and almost nothing about mining.

The geographical scope of this volume comprises the historic counties of Derbyshire, Leicestershire, Lincolnshire, Northamptonshire and Nottinghamshire, and their cities. Structures noted range in date from the Iron Age or earlier earthworks and Roman roads to modern motorways and airport runways.

The volume is in two main parts. The first seven chapters deal with the structures grouped by purpose, chapter 2 (bridges and tunnels) being most relevant to Subterranea Britannica members. These are followed by a 57-page county-by-county gazetteer, a glossary of technical terms, a very useful index of sites, and a remarkably short bibliography. Almost fifty tunnels are featured with, additionally, nine Derbyshire mine soughs (drainage tunnels) and, remarkably, the Fifth Duke of Portland's bizarre Welbeck Abbey tunnels created between 1860 and 1879.

Because many civil engineering works are of necessity very large, and designed to serve for very extended periods of time or even (when built) for the 'foreseeable future', they are difficult and expensive to destroy, so often remain as now purposeless monuments in the landscape. Many are now Listed Buildings and / or Scheduled Ancient Monuments, two statutory designations of 'heritage assets'. Those categories, however, have historically been dominated by stately homes, castles, and venerable earthworks and ruins.

The Institution of Civil Engineers' Panel for Historic Engineering Works has for some years maintained lists of 'Historic Engineering Works' (HEWs), drawing on its extensive archival and library holdings. Between 1981 and 2007 nine volumes covering the British Isles' civil engineering heritage were published, constituting an invaluable and historically and technically reliable overview and containing detailed accounts of the most important HEWs. Barry Barton's *East Midlands* volume is one of a revised version of the ICE series.

NEWS – TUNNELS & TUNNELLING

New tunnelling gallery at London Transport Museum

The Museum's new permanent exhibition, *Digging Deeper*, tells the story of tunnelling from the troubled Brunel tunnel under the Thames in the mid-19th century to the innovations of James Greathead, a pioneering engineer who invented the ground-breaking 'Greathead' digging machine. The display shows how the tunnelling history of the past links directly to the giant tunnelling machines used by Crossrail to construct the new Elizabeth line, which opens in December 2018.

The most striking feature in the exhibition is a giant audio-visual tunnel projection and a life-size recreation of the tunnelling shield that dug the world's first electric tube railway in 1890, overlaid with footage from the Elizabeth line and the latest Northern line extension tunnels.

SOURCE: LT Museum website: www.ltmuseum.co.uk

Aldwych branch platforms at Holborn (LU) could be reused, London

The former Aldwych branch platforms at Holborn tube station may be brought back into use as a part of plans to enlarge the station, subject to a public consultation exercise. Transport for London proposes to construct an additional station entrance from Procter Street, with escalators to the currently disused platforms which would become a new tunnel to improve access to the Piccadilly line platforms.

The present Holborn station entrance would be rebuilt, with new lifts serving all platforms. Subterranea Britannica members who remember our London Study Weekend some years ago will recall the guided tour of the closed Aldwych station which ended with a walk up the branch line tunnel to the disused platforms at Holborn, and the surprised faces of the travelling public as we emerged from an inconspicuous door onto a crowded Piccadilly line platform.





Looking north towards Platform 6 at Holborn in

August 1995, 11 months after closure. Photo Nick Catford

We had all been provided with ‘special’ tickets allowing us to exit via the barriers without hassle, as of course we were unable to buy tickets at Aldwych, which had closed in 1994.

SOURCE: Norbury & South London Transport Club: *The Norbury*, 526 (November / December 2017), page 3.

Funicular railway tunnel project, Capri, Italy

A proposal to build a tunnel linking the port on Capri with the island’s interior has provoked a row, with some residents fearing the project will damage the character of local life. The tunnel would conceal a funicular railway linking Marina Grande to Anacapri, 275m above sea level, to relieve congestion on the main mountain road.

The mayors of Capri and Anacapri are both staunch defenders of the project, which is expected to cost about £89 million and take at least four years to build. Supporters cite pollution, congestion and the fragile state of the five-mile road linking the two towns as ample justification.

The underground funicular would double the capacity of an existing line built at the start of the last century, and extend its range by about 1.2 miles. The tunnel would be about 30m deep, so as not to affect houses; construction work would pause during the peak tourist season; and detritus from the tunnel-boring machine would be carried down to the port on conveyor belts for disposal.

The tunnel is not being built to encourage more visitors, but to reduce the impact tourists make moving around the small island. Capri has already reached its maximum capacity with 2.5 million visitors to the island per year.

SOURCE: *The Times*, 12 March 2018.

New Northern line tunnelling completed, south London

London Underground’s Northern line is being extended from Kennington via a new branch to a terminus at Battersea around three kilometres away, with a new intermediate sub-surface station at Nine Elms. The

extension is to meet the needs of residents at the redeveloped Battersea Power Station site.

Work started ‘on the ground’ (or rather under the ground) in 2015, and the two parallel 3 km bores have now been completed. The new tunnels have been bored at a diameter of six metres, to be 5.2 metres when lined, wider than most on the system to allow for a walkway for emergency or servicing use. The line will be served by trains from the Charing Cross branch of the Northern line.

The tunnels are at a depth of about 25 metres, and mostly through London Clay. Some water-bearing strata (Harwich and Lambeth group beds) were encountered near Kennington. Two tunnel-boring machines, *Amy* and *Helen*, have been used, named after the pioneering aviator Amy Johnson and British astronaut Helen Sharman. They are recoverable and will be returned to their makers in France for reuse.

Access and spoil removal have been via working shafts at Battersea, Kennington Green and Kennington Park. From Battersea, spoil has been taken by barge to Goshens Farm at East Tilbury to raise the land surface.



Careful planning of the exact alignment was necessary to avoid existing tunnels. This called for mapping as precisely as possible all known infrastructure, as well as sinking numerous exploratory boreholes. There are cable tunnels at Battersea, and a storm drain runs just two metres above the new line. Another obstacle was deeper than expected: foundations of a former gasworks at Nine Elms. The new tunnels pass below the LU Victoria line with three metres clearance, and just south of Kennington one of the new bores runs five metres below the Northern line to Morden. At Kennington the new tunnels will connect with the existing loop used by empty trains returning northwards after terminating there.

When the new stations have been created and fitted out, and track laid and signalling installed, the extension is scheduled to open in late 2020. There has been some discussion locally of further extending the line another 3.5 kilometres to serve Clapham Junction.

SOURCE: FENDER, Keith, 2017, Battersea tunnelling completed. *Modern Railways* 74 (831), 52–57.

High-speed railway line to be built under the Old City, Jerusalem

Israel's transport minister has said he was pushing ahead with controversial plans to build a high-speed train network under the Old City in Jerusalem and declared its main station would be named after Donald Trump. Israel Katz's proposal would involve digging two underground stations and excavating more than two miles of tunnel – ending up at the Western Wall, an ancient holy site revered in Judaism.

The project would extend the soon-to-open multi-billion-pound rail line from Tel Aviv to Jerusalem and help ferry the some 11 million tourists and worshippers a year to the wall. The route will run close to – but not directly under – the Church of the Holy Sepulchre, where tradition holds that Jesus was crucified and buried, and a contested holy site known to Jews as the Temple Mount and to Muslims as the Noble Sanctuary. The same area is also home to the al-Aqsa Mosque, one of the oldest in Islam. Palestinians fear any underground work could see the structure compromised.

The project is estimated to cost more than £522m and, if approved, would take four years to complete. Mr Trump gave the Israelis' claim to Jerusalem a major boost after declaring the US would move its embassy from Tel Aviv to the contested city.

SOURCE: *Daily Telegraph*, 27 December 2017.

'Secret codes' and 'Inspector Sams' on the London Underground

A recently published article deals with supposed 'secret codes' used by London Underground to alert staff to matters the travelling public might not want to know about, or might be alarmed by. Panic underground is not a good idea! Codes 1 to 7 apparently refer to soiling by more or less unmentionable body fluids and the like, to slip hazards, broken glass, littering (there are no litter bins at stations) and 'miscellaneous' (unspecified) things station staff may have to deal with.

Your scribe has travelled on LU trains since the 1940s, and recalls hearing none of these staff announcements, but does recall hearing at King's Cross mainline station recently, and elsewhere, the recorded announcement 'Would Inspector Sams please report to the operations room', which is apparently also to be heard on the Underground. It seems there is a (fictional) Inspector Sams at every station!

The cited source suggests this is some sort of fire alert. When your scribe heard this enigmatic message repeated several times on the PA system at King's Cross, although there was no smoke to be seen, he decided to opt for Plan B and head elsewhere for a quiet pint!

SOURCE: *Norbury & South London Transport Club: The Norbury*, 526 (November / December 2017), page 13.

Thameslink's Tunnels open to the public 12 years after they were built

Thameslink's Canal Tunnels opened to the public on 26 February 2018. The new north-south train services began operating through the interlinking tunnels between St Pancras and Belle Isle junction near King's Cross. Initially the service consists of just three trains a day in each direction. The full timetable will begin in May.

Thameslink staff were out in force giving cakes and information sheets to passengers waiting on the platforms for the new services as well as on board the trains. The leaflets handed out stated: 'Today we are giving you the first taste of an historic new Thameslink service between Cambridge and Brighton, and Peterborough and Horsham.'



Canal tunnel shortly after track laying

In a somewhat uncharacteristic piece of forward planning, tunnels were dug under the Regent's Canal to link the Thameslink core to the East Coast Main Line during the engineering works to link High Speed 1 (HS1) to St Pancras Station. The St Pancras International extension included a new Thameslink station (opened 2007) to replace King's Cross Thameslink, and the new tunnel was connected to Thameslink here, with a dive-under junction on the northbound line.

However the link was not fitted out with track and the junction was lifted to prevent wear-and-tear during the many years in which the junction and tunnel would not be in use. At a later date the tunnel would be used to provide this essential link as part of the Thameslink programme. Trains travelling through Canal Tunnels will provide up to eight of the possible 24 services an hour which will travel through central London when the Thameslink programme is completed.

SOURCE: *London Blog*, 26 February 2018 and Thameslink Programme website.

New use proposed for abandoned railway tunnel, West Yorkshire

Long railway tunnels were expensive to make and, even when no longer used by trains, represent potentially valuable assets. Some have even been brought back into use by trains when lines have been reopened.

Three in Croydon are now used by Croydon Tramlink Line 3 trams to New Addington. Others carry communications or power cables or water mains, and some are now back in use as footpath or cycleways. Parts at least of others are now home to mushroom farms or shooting ranges. Boring all those useful holes would have been prohibitively expensive today. It is therefore foolish to completely block or destroy tunnels not currently in use. Worthwhile secondary uses can and do emerge.

A case currently under discussion is the 1.4 miles (2.3 km) double-track rail tunnel on the former Queensbury line between Halifax and Keighley in West Yorkshire, closed in 1956. Highways England currently has responsibility for England's Historical Railways Estate, and is custodian of the Queensbury Tunnel on behalf of the Department for Transport. The official view is that this tunnel should be permanently rendered unusable by back-filling critical lengths (and presumably the five shafts) with concrete, at an estimated cost of £3m.



An alternative view favours bringing the tunnel back into use as a part of a dedicated cycleway in the route from Bradford to Halifax, offering a traffic-free and pollution-free route by-passing the narrow steep roads at present not much used by cyclists or pedestrians.

The very successful mile-long Combe Down Tunnel on the former Somerset & Dorset Railway south of Bath has proved very popular with cyclists since it was brought back into public use in 2013. It has been suggested that work on the Queensbury tunnel for the same ends would cost £4.3m. There would be significant benefits in terms of public health and reduced traffic congestion.

SOURCE: PIDD, Helen, 2018, Campaign to turn abandoned railway line into England's longest cycling tunnel. *The Guardian*, 2 January 2018, page 9.

Channel Tunnel: Eurotunnel to be renamed Getlink
Eurotunnel, the operator of road traffic shuttles (Le Shuttle) through the Channel Tunnel, has revealed it has rebranded itself as 'Getlink', a new name hailed as ridiculous and unnecessary as the short-lived name 'Consignia' for the Royal Mail a few years ago. Through passenger trains (Eurostar) from London St Pancras to Brussels, Paris, and beyond are not affected.

SOURCE: ANON, 2017, Eurotunnel unveils its new identity: Getlink. *The Guardian*, 21 November 2017, page 24.

Steepest funicular railway opens in Switzerland

Swiss engineering and technology have reached new heights with the opening of the world's steepest funicular rail line. The £39.4m Schwyz-Stoos funicular which goes into public service on 17 December has been hailed as a triumph of modern design engineering. A level-adjusting function will allow the space-age-looking carriages, accessible to all users, to remain horizontal while speeding up the mountain at up to 10 metres a second. The line, which includes a tunnel, is in the Alpine resort of Stoos, 4,300ft above sea level in central Switzerland.



The tunnel

The train, two lines of cylindrical carriages, resembling beer barrels, will allow passengers to remain upright at all times, even as they ascend – or descend – the 1,720-metre track, climbing or descending 743 metres along gradients as steep as 110%.

SOURCE: *The Guardian*, 15 December 2017.

Schwarzkopf rail tunnel by-passed and four new tunnels opened, Germany

The steeply graded rail line on the route from Frankfurt to Würzburg is being by-passed by a new line through the Spessart Hills near Aschaffenburg. The 926-metres Schwarzkopf tunnel, opened in 1854, was taken out of service on 15 June 2017, and trains have been using the new line, which includes four new tunnels, since 19 June. The new tunnels include one of 2.623 km and another of 2.691 km. A farewell ceremony was held at the Schwarzkopf tunnel on 25 May, featuring steam as well as electric locomotives. Steam-hauled trains will not be allowed through the new tunnels.

SOURCE: ANON, 2017, Germany: new Spessart line opens. *Modern Railways* 74 (831), page 80.

Rastatt line and tunnel repaired and reopened, Germany

The collapse on 12 August 2017 of one of two bores on a strategically important new high-speed railway tunnel during construction below Rastatt, Germany, was reported in *Subterranea* 46 (December 2017), page 22.

Unfortunately the collapse occurred just five metres below the existing line through the town, resulting in all rail traffic having to be diverted via alternative routes. The purpose of the new tunnel is to allow long-distance, through, and goods trains to by-pass the town with shorter journey times. The tunnel and the existing line have both now been repaired and reopened. The tunnel-boring machine (TBM), trapped by the collapse, had to be retrieved, the damaged bore made good, and stability of the surface line safeguarded as the second bore of the new tunnel is also scheduled to be driven below it.



Concrete has been backfilled into the collapsed Rastatt rail tunnel

The rescue operation was a novel one. 160 metres of the damaged tunnel containing the TBM were filled with

10,500 cubic metres of concrete. Concrete slabs were cast over the collapsed area and over the area where the second new bore was also due to pass under the old line, so effectively bridging the affected zone. The restored surface line was then reopened to traffic, on 2 October. How the blocked section of the new bore is to be cleared is now under discussion. The concrete and the entombed TBM will have to be removed as scrap, probably by excavating downwards from the surface.

There have been international disputes concerning the possibility of re-routing Austrian and Swiss long-distance trains via a non-electrified line in France to maintain services. Since the incident, only around 85 freight trains have been able to run rather than the normal 200. Causes and compensation are also under discussion. Compensation and legal costs, as well as remediation and reinstatement costs, seem likely to be high.

SOURCE: ANON, Germany: Rastatt line reopens. *Modern Railways* 74 (830), 66–67.

New railway tunnel on the Basel – Zurich line, Switzerland

The 2.5 kilometre Bözburg rail tunnel made in 1875 on the Basel to Zurich (via Brugg) route is being replaced for operational purposes by a new one of 2.7 km due to open in 2020. The old tunnel will be kept for services and emergency access. The old and new tunnels are to be linked by five cross-passages. SOURCE: ANON, 2018, Switzerland: Bottleneck tunnel replacement under construction. *Modern Railways* 75 (833), page 81.

Resting in peace, underground, is out of fashion

Paul W. SOWAN

Until cremation overtook burial as the favoured (and cheaper) means of disposing of the dead in England, most people ended up resting in peace underground, usually in wooden boxes buried in the earth, and often stacked one above another in the same grave. My own family grave (in which there is no room left for me!) is stacked four-high. A great-grandmother has been at the bottom since 1911; she was joined by an uncle in 1989; and then by my father and, not long afterwards, the second of my two step-mothers in 2006.

An alternative and distinctly expensive option was to have your coffin sealed into a lead casket which, in turn, was placed in a second wooden coffin and kept on a shelf in a catacomb, such as those some of us visited recently at West Norwood Cemetery.

But some have reached the ends of their lives, or sought to prolong their lives, underground, sometimes in far from peaceful circumstances. Adolf Hitler poisoned himself and his recently married wife (and shot his dog) notoriously in a bunker in Berlin, but directed that his

body should be burned on the surface outside. Several of us have visited the bedroom set aside in a monstrous bunker near Berlin for Erich Honecker, and stood in what was to have been the bedroom of Josip Tito in a mountain bunker near Starigrad Paklenica in Croatia. Saddam Hussein was cornered hiding in a hole in the ground, as was Muammar Gaddafi, and Laurent Gbagbo was cornered in his own bunker in Abidjan, Ivory Coast. An addition to the list of unsavoury characters who have made use of underground space is the late Donald Neilson (the ‘Black Panther’). Then of course Charles Dawson, the prime suspect in the Piltdown Man hoax, had a fascination for underground places: he conducted a frankly chaotic archaeological excavation in the long-lost Lavant Caves on West Sussex, and claimed to have descended what he chose to call a dene-hole (a single-shaft limestone mine) in East Sussex.

No doubt members can extend the list of the infamous who have favoured holes in the ground.



The Surrey hearthstone mining industry and the hearthstone trade

[First published in Newsletter Surrey Industrial History Group 217 (2018), 15–18]

Paul W. Sowan



Mined hearthstone gallery at Marden. Almost all the rock was taken out for sale. Spoil is represented by minimal amounts of rock containing chert nodules. Note the irregular gallery walls with wedge marks

Currently accessible tunnel complexes at Gatton, Merstham and Chaldon were worked almost exclusively as quarries for building-stone. Several at Godstone were also mined for hearthstone. At Bletchingly, Brockham and Colley Hill (Reigate) hearthstone was the main or sole product.

In the first half of the 20th century, hearthstone was a well-known material in the domestic scene, usually kept under the kitchen sink, or in the scullery. It was a mineral pigment used to whiten natural stone surfaces such as hearths, doorsteps and flagstone floors. Samples are usually to be found in reconstructed 19th- or early 20th-century shops and sculleries in open air museums such as at Amberley, Beamish, or the Black Country.

BLANCHARDENE STEP CLEANER

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DOOR STEPS, WINDOW SILLS, STONE STAIRS, &c.
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GEO. BLANCHARD & CO.,

LONDON HEARTHSTONE WORKS,
237, WALWORTH ROAD, S.E.

QUARRIES: BETCHWORTH, SURREY.

I noted some at Cheddleton flint mill during an AIA visit last year, and more is displayed at the Brewhouse Yard Museum at Nottingham. As usually encountered, hearthstone was sold as small rectangular blocks of crushed stone moulded into shape, or as powder in sprinkler canisters. It was mined in east Surrey from the Upper Greensand beds which lie below the Chalk but above the Gault Clay, outcropping along the foot of the North Downs escarpment.

Hearthstone was much used to smarten doorsteps of terraced houses lacking front gardens in northern industrial towns. And, just as painted platform edges are still found on dimly lit railway station platforms, hearthstone was probably used on stone staircases in





This was the last mine to be worked in Surrey, closed in about 1960 / 61. This was the only entrance, as photographed possibly in the 1930s, but it looked much the same when the author saw it in or about 1959. A single narrow-gauge line of rails ran straight into the hillside for about 400 feet, giving access via turntables to several headings, where stone was extracted, at right angles on the left-hand (west) side. A plan of the then active mine was made in 1941 by the Reigate borough engineer, presumably for possible use as an air-raid shelter. It shows that the tunnelling then in use has been driven through previously mined ground nearer the entrance and on the east side, indicated sketchily as 'old workings'.

This entrance is now completely blocked and the heavily timbered entrance tunnel is known to be extensively collapsed. The mine was reopened briefly in 1982.



Colley Hill hearthstone mine in 1956. Mined stone is being conveyed to the nearby on site factory by Alfred Turrell and the horse 'Stocking'. The narrow-gauge line has a gradient downwards to the north, into the mine. Photo by Michael Ross

equally dimly lit workhouses, factories, infirmaries, and such places. Surprisingly, a great deal of this humble material came from the mines in east Surrey. How and why the hearthstone trade originated and how it became dominated by mining enterprises in Surrey is far from clear.

The first recorded occurrence of the word 'hearthstone' as a mineral pigment recorded in the Oxford English Dictionary is from 1840. In *Peter Parley's Annual* (a Christmas or New Year's volume of stories for children), we read (page 15) that 'Mosette with her wet feet left many black marks on the hearth-stoned kitchen floor'.



Colley Hill mine hearthstone factory. Lumps of stone from the mine can be seen in a stockpile. The large lumps were broken into smaller pieces and then ground to powder to be moulded into small blocks. Completed blocks are seen here set out to dry. A stockpile of pit props is seen on the right. The large stone slab on a trolley may have been intended for use as a hearth, rather than for whitening a stone hearth



Colley Hill mine hearthstone factory c1910. Completed blocks are seen here set out to dry. Covers to protect them from rain can be seen

Peter Parley appears to have been a pseudonym used by William Martin [1801–67]. Henry Mayhew [1812–87] in his *London labour and the London poor* (1851), writing about street traders, mentioned 'the hearthstone barrow, piled up with hearth-stone, bath brick, and lumps of whiting'. Hearthstoning the doorstep is a domestic chore often mentioned in recollections of working-class urban life.





Colley Hill hearthstone factory c1910. Here, slabs of stone are being cut into small blocks instead of moulded. Completed blocks were taken by cart to a railway siding to the west of Reigate Station for transport to London

Rise, extent and decline of the hearthstone mining trade

The once-flourishing hearthstone trade depended in large part on the products of mines or underground quarries at Brockham, Betchworth (two mines), Reigate and Godstone (something like five mines), with probably some much smaller-scale working at Gatton and Merstham. These evidently commenced production of



Hearthstone processing factory at Colley Hill c1910. This was the only Surrey hearthstone mine where processing was done at the mine. Ground hearthstone, possibly mixed with a small quantity of 'binder', is being compressed in a mould into rectangular blocks for sale. The factory was destroyed by a fire shortly before the mine closed

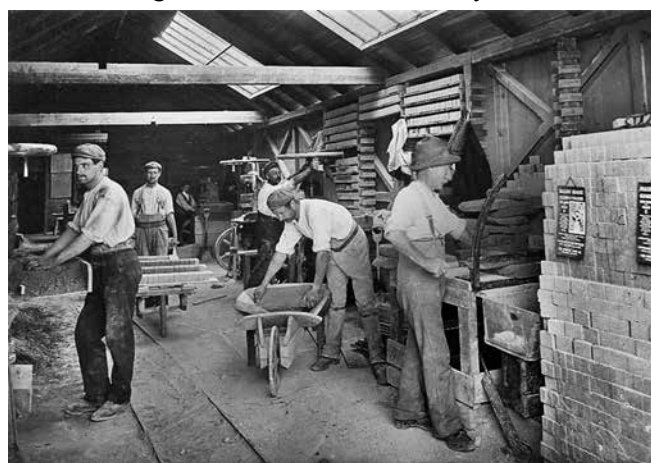
the pigment in the 19th century and continued into the 20th, the last mine to close being that operated at Colley Hill, Reigate, by Reigate Mines Ltd in or about 1961.

The sometime Hearthstone & Whiting Trades Association was incorporated as a limited liability company in 1920 and had as members listed in 1925 the Godstone Mines, the Brockham Lime & Hearthstone Co. Ltd, Reigate Mines Ltd, and the Surrey Mining Company Ltd (at Betchworth). However, by then this was a declining trade. Claude William Cawley's mine at Betchworth had closed before World War 1, and the Brockham Company abandoned its mine in 1925. The problem of engaging domestic servants, and the introduction of red quarry tiles for hearths and doorsteps, were to blame according to one company source.

Quarry waste

The hearthstone trade, at least in Surrey, appears to date from around 1820. Working the very much older underground building-stone quarries, from the Roman period onwards, generated very large volumes of quarry waste in the course of extracting squared blocks of Reigate (or Gatton or Merstham) stone. This waste was useless for building purposes, consisting of small and irregular chippings generated in cutting out the blocks and rough-shaping them underground, and also probably came from beds of rock too thin to yield useful sized blocks.

Many accounts suggest the hearthstone was found in distinct beds of a different mineral nature, although detailed analysis of the mineralogy of stone samples fails to support that contention. This very fine-grained rock consists mostly of several kinds of the mineral silica, mostly chemically precipitated cristobalite with smaller proportions of chert-like amorphous silica and quartz sand grains. The remainder is mostly calcite, feldspar, white mica, glauconite and traces of clay minerals.



Hearthstone processing factory at Colley Hill c1910. The various processes used in transforming the hearthstone from its raw state to the finished product are seen here

Although often referred to as a calcareous sandstone there is insufficient crystalline quartz to justify the term. It is neither calcareous sandstone nor sandy limestone, and has no formal geological name. Similar material found locally in France has been called *gaize*. In reality, almost

all the stone beds in the Upper Greensand mine and quarry tunnels would make acceptable hearthstone, whereas only certain beds were thick enough to be useful for building and had relatively satisfactory resistance to weathering.

In the beginning

An unidentified entrepreneur at an unidentified location appears to have seen and seized a market for the waste, and founded the hearthstone trade. The most likely candidates for this initiative may well have been the Hall family at Merstham from, it has been claimed, 1824 onwards.

They had succeeded Jolliffe & Banks as operators of the chalk pits, lime kilns and underground quarries at Merstham, a pioneering civil engineering partnership which had supplied greystone lime to civil engineering works as far distant as Howth Harbour near Dublin, and Heligoland near the German coast, as well as docks and harbours and bridges in London and the southeast and other places in England.

The Croydon, Merstham & Godstone Iron Railway, which opened between Merstham and Croydon in 1805, extending the Surrey Iron Railway from Wandsworth to Croydon that opened two years earlier, obviously facilitated access to the London market and beyond.

There is some evidence for small-scale production of other rocks in other locations for use as mineral pigment for natural stone surfaces, although what is known so far suggests that the east Surrey mines dominated the market, even supplying the industrial cities of northern Britain.



Quarry gallery at Godstone Hill from which spoil has been removed, possibly to make mushroom beds and / or for sale for hearthstone. Note the characteristic smooth walls with arcuate pick marks.

Note also the line of chert nodules near the floor

Artificial hearthstone

So flourishing was the demand for hearthstone, in its day, that at least 26 patents for ‘artificial hearthstone’ were applied for by parties throughout England and even southern Scotland. It is, of course, very difficult if not impossible to assess the commercial success of these patents, which often specified various chemical industry waste products as ingredients.



Loose spoil in the quarry areas of Marden.

In other places this has been stored behind dry stone walls
But it is probably significant that James Hall [1814–1890] of Horley registered a provisional patent 3712 in 1875 for ‘improvements in the manufacture of artificial hearthstones’. This called for ‘ground green sandstone found above the Gault Clay in the neighbourhood of Betchworth in Surrey and in other localities mixed with Portland cement and moulded into blocks’.

The Hall family had for a short period an interest in the chalk pits and Upper Greensand at Betchworth as well as at Merstham, noted in Robert Hunt’s *UK Mineral Statistics* for 1858, but not mentioned in C.G. Dobson’s history of the Hall company (although James Hall’s patent is noticed).

Documentation and archaeology of hearthstone mining

Mine and quarry tunnels in the Upper Greensand are still accessible at Gatton, Merstham, pre-1933 Chaldon, and Godstone. Those at Gatton, Merstham and Chaldon were worked almost exclusively for building stone or, on a smaller scale, for making (rather than whitening) stone hearths.

At the several sets of tunnels either side of, and underneath, the A22 at Godstone Hill, however, areas exclusively exploited for squared building-stone are



The development of the galleries at Marden relative to rock joints left mine ceilings very liable to collapse. Note the pit props which have failed to support the ceiling



During WWII the western (quarry) part of Marden was cleared of spoil and used as a secure bonded store. The eastern part was used as a hearthstone mine. The internal secure boundary included a subterranean steel door

recognisable, and quite distinct from areas mined for hearthstone. In the quarry tunnels, all or most of the quarry waste has been left underground or, in places, subsequently taken out for sale as hearthstone. Very distinctive toolmarks are left by picks and wedges where squared blocks have been removed.

In hearthstone mining the material was hacked out in smaller and irregular lumps, leaving quite different pick and wedge marks on the working faces and mine walls. And as almost everything apart from lumps of stone containing chert nodules was taken out, very little waste has been left underground.

Conclusions

At first, hearthstone was exploited as a means of getting rid of by sale otherwise useless waste from building-stone quarries. Later, as at Godstone, both building-stone and hearthstone were worked at the same time. And by the 20th century new mines, as at Betchworth and Brockham, were worked exclusively for hearthstone. Exactly by whom,

when, and where in east Surrey the trade originated is not clear, although this somewhat obscure rural industry appears to have dominated the British market.

Further information

The industry in Surrey is relatively, if patchily, well documented, and such company records as I have rescued for Brockham, Betchworth and Reigate, especially, have all been deposited at the Surrey History Centre at Woking. And as I commenced researching this east Surrey industry in the early 1960s, I have enjoyed interviewing some of the last miners to work underground in the county.

More recently Peter Burgess of the Wealden Cave and Mine Society has continued this research underground and in archives, engaged in further oral history projects, and examined newspaper files. A small team (of which I was a member) of WCMS members has completed a detailed survey of the extensive mine and quarry tunnel complexes as Chaldon and Godstone, and smaller sites at Gatton and Merstham.

Nick Catford has made an excellent photographic record of the underground workings. Some of his images have been published in his 2013 volume *Secret Underground London* which features sites in and around Greater London more or less as bounded by the M25, especially in pages 256 to 277. The Croydon Caving Club and WCMS websites provide convenient access to much relevant information and many subterranean photographs.

Books and articles such as the following are also recommended:

BURGESS, Peter M., 2008, *Surrey's ancient stone mines*. Crawley: author: 204pp [ISBN 9780-9556-0811-7] and SOWAN, P.W., 1976, *Firestone and hearthstone mines in the Upper Greensand of east Surrey*. Proceedings Geologists' Association 86(4), 571-91.

Archive photographs from the author's collection now at the Croydon Natural History and Scientific Society.

Colour photos by Nick Catford

Rob Armer (1954-2017)

We are sorry to report the death of Sub Brit member Rob Armer. Rob, who had been a member for 10 years, was a frequent attendee at our Spring Meetings and AGMs. Until ill health including failing eyesight prevented it, he also attended a number of organised trips.

He first worked for London Transport, becoming an Inspector and working his way up to being a 'Gold Badge' on Green Line services. Some of his other hobbies reflected his work and he collected transport models and bus signage. He later worked for the Home Office on matters concerning victims of crime until moving to Devon. Here he worked as a paramedic and did extensive voluntary work.

In recent years Rob developed diabetes but he didn't let his health troubles stop his enjoyment of life. After moving into sheltered housing, he embarked on and enjoyed a number of cruises.

Whilst aboard the cruise ship *Ventura* in the Mediterranean in May he suffered a heart attack and was hospitalised in Mallorca. Optimistic even then, he emailed from his hospital bed saying, 'I mean to live, I have lots to do and lots of people to annoy and bore!'

He was well enough to be airlifted back to the UK but sadly died of another heart attack whilst in Torbay Hospital.



Business as usual at Paddock

Nick Catford



Open day at Paddock in June 2016. L – R Maria Michael, Roy Kenneth (guide), Katy Bajina, Winston Churchill (Stan Streather), Andrew Smith (guide). Photo Nick Catford

On 14 October 1938 the final plans were drawn up for the construction of a bombproof war headquarters deep underground at the Post Office Research Station in Brook Road, Dollis Hill, London, NW2. The purpose of the bunker, initially named CWR2, was to duplicate the facilities of the Cabinet War Room (CWR1) in Whitehall. CWR1 was a strengthened existing basement which would probably not have survived a direct hit.

The purpose-built bunker at Dollis Hill was designed to survive a direct hit from the largest high explosive bomb that Germany could deliver and was intended to act as a standby to CWR1 in the event of the central London facility being destroyed or disabled during an air raid. The two major rooms in CWR2 were the map room and the cabinet room, both located in the sub-basement 40 feet below ground.

Paddock opens and is quickly abandoned

Construction work and fitting-out were finished by June 1940 and CWR2 was ready for use by the War Cabinet. It was immediately manned by a skeleton staff to ensure that it was in a state of permanent readiness and was given the code name PADDOCK.

PADDOCK's life as a war room was to be short lived, and in the summer of 1943 Churchill warned about the progress of German plans to bombard London with V-weapons. He chose as his own safe place not PADDOCK but the bottom floor of a new purpose-built bunker in the North Rotunda (code name ANSON) in Marsham Street, Westminster.

In the autumn of 1943 the best of PADDOCK'S furnishings and furniture were removed to the North Rotunda. PADDOCK had now served its purpose and was redundant. A skeleton staff remained until the end of 1944





*Filming Durrty Doodz video 'Oi Wot U Lookin' At' in 2010.
Photo Nick Catford*

when the bunker was finally locked up and abandoned.

A new use for the bunker

Part of the Dollis Hill site was acquired by the Network Housing Association in May 1997. Planning permission was obtained for 99 new homes including 37 new-build houses. The main Post Office building, which is locally listed by Brent Council, was retained and converted into 28 luxury flats. As a condition of the sale Brent Council required Network Housing to make the underground bunker safe and open it on at least two days a year to the general public for a period of five years.

The new housing development was completed in May 2000. In line with Brent Council's requirements Network Housing (now Network Homes) spent £15,000 on the bunker including pumping out two feet of water that had settled in the sub-basement when the fabric of the structure was damaged during the construction of the new houses above. Pumps were fitted and lighting installed on both levels and in many of the rooms.

The first open day was held on 17 April 2002 in a blaze of publicity with both national, local and foreign press and TV coverage and a Vera Lynn look-alike to open proceedings.



Still from BBC 3 Drama 'The Fades'

Joint venture between Network Homes and Subterranea Britannica

The open days at Paddock have always been a joint venture by Subterranea Britannica and Network Homes.

The housing association maintains the bunker and organises two public open days a year, one weekday in spring primarily for local people and schoolchildren, and a Saturday in September as part of the London Open House weekend. They also take bookings, send out confirmations and maps to the visitors, book two portable toilets and arrange refreshments for the helpers throughout the day.

Sub Brit provides the helpers and tour guides and runs the tours throughout each open day. Tours last just under an hour and can run every half hour from 09.00 – 17.00. With up to 25 people on each tour as many as 500 people can be shown round the bunker on a busy open day. This requires a lot of helpers with 20 to 25 Sub Brit members usually attending on each occasion.

This co-operation between the housing association and Sub Brit has worked well since 2002. Network always sends someone along to take charge of each occasion. Initially this was Maria Michael, PA to Network's CEO. Maria has always had a personal interest in the bunker and its history and was instrumental in setting up the open days and asking Sub Brit to run the tours. Maria left Network in 2006 and her place was taken by the CEO's new PA, Katy Bajina; Maria stayed on as a volunteer to help Katy.



Suggs from Madness with Nick Catford in the generator room during the filming of Disappearing London broadcast on 9 January 2007

Katy was continually impressed by the enthusiasm of the Sub Brit volunteers who always turned out in large numbers whatever the weather.

Katy was also responsible for hiring out the bunker, especially for use as a film set. The bunker has been used for a major BBC TV drama *The Fades* starring Iain De Caestecker (Adam Barlow in *Coronation Street*) and for a grime rap video by Durrty Goodz (Dwayne Mahorn). It has also featured in numerous documentaries, most recently Channel 4's *Hidden Britain by Drone*.

It has also been possible for other organisations like English Heritage to book the bunker for private tours. All of these external bookings also required helpers from Sub Brit.



All change at the top

Katy Bajina retired from Network at the end of March this year. Network's Chief Executive Helen Evans has agreed after careful consideration that because of the continuous interest from the general public wishing to visit the bunker, the two public open days can continue with priority being given to local schools during the late spring opening.

Maria Michael has kindly volunteered to step in and take over responsibility for arranging the tour bookings for the two open days. Maria will liaise with Network to arrange and manage all the internal administration for getting the site ready before the event.

Because of the lack of resources within Network Homes to manage the site, any future requests for the hire of the bunker – whether for group bookings, TV/film crews who are looking to use this site for productions, or for any other purpose – will be declined.

'Thank You' Sub Brit

Katy will make her final appearance, as a volunteer, at the next open day on Thursday 7 June. In a recent statement she said, "I would like to personally thank you and all the volunteers for their support over the last 17/18 years. I can't say I will miss standing outside 109 Brook Road in the cold, the wind and the rain, but I will sincerely miss you all including the public who have over the years with their immense gratitude kept me going to look after this site for so long."



Maria Michael now in charge of taking bookings on behalf of Network Homes. Photo Nick Catford

Katy will be missed, but as far as Sub Brit is concerned it is still 'Business as usual'.

Further information: Sub Brit website

Oi Wot U Lookin' At by Durrty Goodz is at: <https://tinyurl.com/l37mnaz>

The Fades Episode 4 which features Paddock is at: <https://tinyurl.com/y7zffjvc>

Disappearing London Series 2 Episode 1 is at: <https://tinyurl.com/ybwlrjvm>

Why take matches and candles underground?

Matches and open flame lamps should not, of course, be used in any underground space where methane may be present. Coal mines worldwide have a long and dreadful record of methane and / or coal dust explosions, with huge loss of life. It is less well-known that mines and underground spaces other than in the UK coalfields can also be hazardous on account of methane. A life was lost from a methane explosion in the Mountfield gypsum mine some years, and several were lost in a subsurface water company facility at Abbeystead in Lancashire. Methane can result from decaying organic matter, hence its older name 'marsh gas'.

But in methane-free spaces, candles have several uses, as follows:

[1] Lighting. Candles, hard to keep alight if you are on the move, aren't really at all satisfactory as the back-up lighting you should always have with you underground. However, it is good to be reminded what the underground space looked like to those who first dug or explored it. Direct strong beams from electric head lamps do not reveal subtle tool-markings anything like as well as side-lighting by candle-light.

[2] Candle flames go out in air seriously depleted

in oxygen. If you have difficulty keeping the candle alight, it is time to go! Lowering a lighted candle into an unexplored hole is a means of finding out if the air down there is life-sustaining. Dropping a lighted newspaper down a mine shaft has also been suggested as a check for methane: stand clear, just in case! Carbon dioxide is denser than air, so tends to accumulate in low points in still air, whereas methane is less dense, and collects at the ceiling.

[3] Candle flames detect draughts. This is helpful if you want to know what seems like an impassable rock fall is a dead end, or has open tunnel beyond it. If a current of air is issuing from it, or passing into it, the passage probably goes on.

[4] Candles can indicate the passing of time. If you are working at some point underground, and know how long it takes for the candle to burn down an inch, you have a helpful reminder of how long it is until the pub closes!

[5] A candle flame behind your tripod-mounted camera is helpful if you are moving about in front of it (while an assistant covers or uncovers the flame): if you can see the candle, you are in the view from the camera.



A trip through the Standedge Canal Tunnel

John and Rosemary Collett

This article dates from some years ago and we are publishing it now in memory of former Sub Brit members Rosemary and John who died in 2013 and 2017



*A view through the unlined Standedge tunnel.
Photo Peter Scott*

Some members of Subterranea Britannica may know that we have a 30 ft Sea Otter aluminium narrow boat. For some years we used it based at Walton-on-Thames, and travelled most of the southern waterways and into the Midlands. Then, to avoid having to return to the Thames, we cruised ‘continuously’, finding temporary and overnight moorings where we could, and to suit our journeys to and from home in Surrey by train as much as possible so as to avoid the need to return to a car left at our setting-out place, although this has often resulted in some interesting trips to get to a mainline station and back to the boat.



The Diggle portal

Winter moorings have been at Upton-on-Severn, Preston Brook near Runcorn, Burton-on-Trent, Lincoln, Rotherham, Worsley near Manchester and, this winter; Dewsbury, so we have been through many of the canal tunnels, and rail ones too.

Last year we crossed the Pennines by the Rochdale Canal, over forty locks to the summit, and about the same down to Manchester on the way to the winter mooring at Worsley on the Bridgewater Canal, where the Duke of Bridgewater’s coal mines and their underground canals emerge at the Delph.

After a visit to Liverpool and stay at the Salthouse Dock we returned east and booked a passage through the Standedge tunnel with the British Waterways office at Stoke-on-Trent.

We duly arrived at Diggle for our booked passage and, after boats from the east had emerged and their ‘chaperones’ landed with their gear, our boat *Magdalen* was measured: height above water, maximum width and across the cabin top. Having satisfied those in charge that our boat would go through the tunnel we were issued with hard hats, life jackets, a fire extinguisher, and lamp.



Two views through the unlined tunnel. Photos by Peter Scott



With all this loaded aboard, we then had a safety talk. As suggested, I then removed the navigation lights fitted to our boat. This all took quite a while, and explains why British Waterways are only allowing three passages each way through the tunnel, three days each week.

At last we were away into the tunnel with our rather chatty 'chaperone' who steered for a bit: not too easy, I found, since this is by tiller from the boat's stern, so you have to stand up well to see over the cabin and look out for the low parts of the tunnel roof. It was not long before I appreciated the hard hat, and added to scratches on it and on the boat when we reached the unlined bare rock parts of the tunnel.

In fact, not much of the tunnel is lined with brickwork. There are some brick relieving arches, and parts concreted or rock-bolted. In several places there are quite severe kinks in the tunnel alignment where it is driven through bare rock, so we went slowly, and were the best part of two hours in the dark, other than the light of our own headlamp.

As this first of the four Standedge tunnels was used to take away spoil excavated from the first railway tunnel, there are cross-tunnels between the two. At some cross-tunnels we stopped while our British Waterways man reported to 'control' by a fixed telephone on the wall. At one of these cross-tunnels we were allowed to get off and examine the brick-lined (now disused) railway tunnel, several feet higher than the canal: it seemed vast compared with the one we were navigating, although it was constructed only for a single railway track.



One of the cross tunnels. Photo Mitch Preston

Locked out

We emerged at Marsden, where we moored and spent the night since the first lock was padlocked until the next morning. This was a welcome stop as we had done eight locks before entering the tunnel, luckily with another boat short enough for us both to get in together. These approach locks are chained up until the first morning boat is booked through the tunnel.

Here at the east end is the tunnel visitor centre, in a former warehouse. The display was a little disappointing to us, and I expect Paul Sowen when he gets there, as

there is not much on the details of surveying and tunnel construction. The single-handed boater who had joined us up to the tunnel and followed us through knew the area well, and the day ended with a pleasant evening with him at a pub offering its own brews.

Next morning we set off for Huddersfield, which became a slow trip due to a shortage of water. The Leeds & Liverpool Canal had been part closed by British Waterways for a week or so because of this. Fortunately our own boat is of shallow draft, under two feet, but we did go aground in a couple of places and opened paddles to fill the pound we were in. Some boaters we met going up to Marsden had spent a night stuck on the bottom, and one picked up a piece of carpet on their propeller that took an hour or more to release.



The former canal warehouse at Marsden is now a visitor centre. Photo Richard Southwell

Further towards Huddersfield we passed through a couple more tunnels, quite short concrete ones which have been built at places where the canal had been filled-in when it



The Standedge Tunnel was officially opened on 4 April 1811. A special trip boat is seen emerging from the Diggle portal on the 150th anniversary in 1961. The trip was organised by the Railway and Canal Historical Society. The narrowboat left Marsden around 11 a.m. and emerged from the Diggle portal around 1 p.m. The last commercial boat to use the tunnel passed through in 1921 and the canal was officially closed in 1944 after which it soon fell into disrepair



was abandoned and built over. One of these has a dogleg, but wide enough for boats to pass and fairly short. We left *Magdalen* at Huddersfield by the basin where the canal continues northwards, becoming wide enough for 14' x 70' boats.

Locked in

The canal from here all the way to Manchester is narrow and only usable by 7' x 70' vessels, with over forty locks down from the summit. All these locks we found in good condition, unlike those down to Huddersfield some of which have hard-to-operate paddle gear.

As usual we returned home by train, from Huddersfield. This station has a very fine frontage facing a plaza with fountains and a statue of Harold Wilson. Our train home took us through the fourth Standedge tunnel, the double-

track tunnel still in railway use. It seemed a very long tunnel, even at the speed of a train.

British Waterways have an electric boat at the Marsden tunnel depot, and offers public trips into and sometimes right through the tunnel. They also have the use of the adjoining disused railway tunnel for emergency vehicle use, on account of the numerous cross-tunnels to the canal.

So *Subterranea Britannica* might, perhaps, with British Waterways cooperation, be able to arrange a rail, road and water trip of over nine miles underground. To which could be added a walk over the top of the tunnels, to appreciate the surveying called for by the canal tunnel construction, and shafts sunk for raising tunnel spoil and allowing access for the canal tunnel miners.

World War II public air-raid shelter rules at Reigate, Surrey

The Borough of Reigate was fortunate in having a number of underground excavations, known locally as the 'caves', in and around the town centre, some of which were used during World War II as deep shelters. The Borough Council used, especially, the former sand mines either side of Tunnel Road for this purpose, the entrances being within the tunnel. A poster preserved in the Borough's World War II archives at the Surrey History Centre at Woking makes interesting reading. It lists 21 rules in over 30 paragraphs written in wordy 'officialese' which one rather doubts if persons hurrying underground as the air-raid sirens wailed would have stopped to read! Readers learn from the preamble that the rules were made under Paragraph 1(a) of Regulation 23AB of the Defence (General) Regulations 1939, and that each shelter had a designated number of spaces, that being the maximum number of persons to be allowed admittance.

Rules 3(a) to 3(g) stipulate that, amongst other things, a person shall not ...

Enter or remain in a shelter if he is drunk or if his person or clothing is offensively unclean or verminous;
By forcible or improper means enter or seek to enter any sanitary convenience in or appurtenant to the shelter, or knowingly intrude upon the privacy of a person using such a convenience;

Give or receive any money or valuable money or thing as consideration for keeping or reserving or making available any place in a shelter;

Take into a shelter any loaded firearm.

One can imagine barrack-room lawyers taking in unloaded firearms and separate ammunition: there is no rule prohibiting the loading of guns once inside!

Rules 4(a) to 4(f) state that, amongst other things, shelterers shall not ...

Wilfully make any mark on, or affix any bill, placard or advertisement to any part of the shelter;

Smoke, sing, or play any musical instrument in a shelter;



Tunnel Road East mine in Reigate, one of the large public air-raid shelters in the town. Photo Nick Catford

Beg, or collect money, or sell or offer for sale any article, or distribute any printed or similar matter;

Take into a shelter any dangerous or offensive article, or any apparatus for heating (except hot water bottle) or cooking;

Take into a shelter any animal or bird, or any perambulator or other vehicle, or any article of furniture or bedding (other than portable stools or coverings or cushions).

However, rule 18 provides that 'Subject to any instructions given by the local authority a shelter warden may, with respect to any shelter under his control, authorise on such conditions as he sees fit a relaxation of the provisions of rule 4 thereof'. So a morale-boosting sing-song was possible with permission, the family pet could be brought in if the warden allowed it, and the wartime graffiti in the Tunnel Road West shelter may have been sanctioned. SOURCE: BOROUGH OF REIGATE, 1941, Public shelter rules [Printed poster dated 31 March 1941]

Portsmouth & Isle of Wight Study Visit 11-13 August 2017

Jason Holdcroft



Looking up the steep eastern steps (179 steps) down into the WWII underground combined headquarters at Fort Southwick. The depth of the underground HQ varied according to the slope of the hill, but was in the region of 80-100 feet. Photo Clive Holden

With its situation on the English south coast facing Europe across the narrow Channel, Portsmouth has been implicated in the defence of the British Isles against foreign invasion from at least the days of the Danish Viking raids.

The first permanent military fortifications were built in the reign of Henry V and, as the home of the Royal Navy, Portsmouth has seen its defences constructed, destroyed, replaced and redeveloped for generations.

Lying around four miles away across the Solent, the Isle of Wight hosted its own outposts for the protection of the mainland, particularly in the twentieth century. The sites and structures left behind by defence and fortification over the last two centuries formed the programme for a Sub Brit study weekend in August 2017, led by Alistair Graham Kerr.

On 11 August, a group of around thirty Sub Brit members arrived in Portsmouth and enrolled at the University of

Portsmouth's Rees Hall near the Southsea seafront for the weekend. Rees Hall was originally a Victorian hotel and retains some of the external features, with the inside being very much what you might expect from a 1990s student hall of residence. The building is just a short walk from the seafront at Southsea and near to Portsmouth Historic Dockyard and its many attractions.

Day 1: across the Solent

After a night's sleep, a good breakfast was had before we set off for the hovercraft to the Isle of Wight. Having begun transporting passengers in 1965, Hovertravel is the oldest hovercraft operator in the world and the only commercial hovercraft route in western Europe.

The extent of the low tides at Ryde means that it is not possible for ships to berth near the town, and while the ferries sail to the end of the third of a mile long pier, the hovercraft is able to land passengers a short hop from the centre of Ryde whatever the state of the tide.





The Sub Brit party boarding the Solent Flyer hovercraft.

Photo Adrian Armishaw

The weather being good, and certainly not threatening the Force 8 gales which would see hovercraft crossings suspended, we had a smooth ride lasting about ten minutes. To the delight of our group, the pilot allowed some members to take a look at the bridge of the modern craft.



Our trip leader Alistair takes a peek at the bridge.

Photo Jason Holdcroft

A hovercraft is essentially an air cushion vehicle, neither an aircraft nor a boat. Although the concept had been around for over a century, they are generally regarded as a British invention, most often associated with British mechanical engineer Sir Christopher Cockerell (1910–99). In the 1950s Cockerell's group was the first to develop the use of an annular ring of air for maintaining the cushion, the first to develop a successful skirt, and the first to demonstrate a practical vehicle in continued use. They are now used throughout the world as specialised transports in disaster relief, coastguard, military and survey applications, as well as for sport or passenger service. Very large versions were used to transport large numbers of people and vehicles across the English Channel, whilst others have been used to transport tanks, soldiers and heavy equipment in hostile environments and over uneven or marshy terrain.

Cross-Channel services ceased in 2000, partly due to noise and fuel cost issues, but mainly due to competition from high-speed ferries and the Channel Tunnel.

'The Island Line'

After a short break and an opportunity to find a cup of tea and enjoy the sunshine, we gathered at Ryde Esplanade Station at the landward end of Ryde Pier, and caught an Island Line electric train dating from 1938, formerly in service with London Underground's Northern line and still going strong (if a little bumpily) after extensive refurbishment.

The restricted loading gauge of the railway, especially through the tunnel under Ryde, is one reason for these old tube trains being still in use. The line was electrified in the Beeching era and 43 LU units were brought to the Island on the car ferry.

Running a total of 8.5 miles from Ryde to Shanklin, the Island Line is now part of the privatised South Western Railway. The first services ran on 23 August 1864. A 1,312-yard tunnel was cut through St Boniface Down (beneath our first site) for an extension to Ventnor which opened a few years later. The station at Ventnor is now an industrial estate but the tunnel entrance is visible nearby.



An ex-London underground tube train is seen arriving at Ryde Esplanade station from Ryde Pier Head. The class 483 stock dates from 1988 making them the oldest passenger rolling stock operating timetabled services on the national rail network. Photo Adrian Armishaw

RAF Ventnor

Having reached the Grade II listed rail terminus at Shanklin, we had a picturesque coach ride and a short walk to St Boniface Down, the location of our first visit, RAF Ventnor Chain Home Radar Station. Facing south and climbing steeply above the village of Bonchurch, St Boniface Down is named after an eighth-century saint and forms part of the National Trust estate of Ventnor Downs. Its position and elevation made the site ideal for a coastal radar station to provide long-range warning of any incoming attack by air, and in 1937 it was one of twenty so-called Chain Home radar stations to be approved by the Air Ministry.

In order to ensure immediate coverage, the site initially had experimental transmitters and receivers in temporary buildings, before the substantial 240ft receiver towers and 365ft transmitter towers were constructed.





RAF Ventnor – three steel transmitter towers in the foreground and four timber receiver towers in the background.

Painting by John Finch

A fourth transmitter tower was due to be completed but a reduction in the number of operating frequencies of these stations meant that it was no longer required, as two arrays could be suspended between only three towers, and so it was dismantled and sent to the Shetland Isles for use there. The station went on 24-hour watch from Easter 1939 and was ready for war operations from the following August.

World War II developments

On 12 August 1940, German bombers attacked radar stations at Dover, Rye and Pevensey before striking Ventnor. Although they were intercepted by the RAF early in the Ventnor raid, nonetheless most of the buildings were damaged and the station went offline. The station was repaired and became operational again in November 1940.

In the meantime, a temporary mobile station operated from Bembridge on the Island. The Luftwaffe attacks prompted the Air Ministry to propose reserve equipment at most CH stations which would be either underground or sited some distance from the main site. At Ventnor, buried reserve equipment was available from the middle of 1942.

As the state of the technology progressed through World War II, Ventnor saw several new developments. In March

1942 a height-finding microwave Type 13 radar was installed and in the spring of 1943 the station received a mobile Type 14. Towards the end of 1942, a mobile installation for producing jamming signals against German radar became operational, aimed towards the Cherbourg Peninsula.

In September 1943, cathode-ray-tube Direction Finding equipment was installed, providing more accurate



The Variable Elevation Beam building located below one of the receiver masts. The concrete base of the mast is seen on the left. Photo Adrian Armishaw

measurement of the direction of incoming aircraft. As invasion forces gathered nearby prior to D-Day the following year, Ventnor provided radar coverage of five hundred aircraft guarding more than 1,600 seaborne craft assembling prior to the assault.

Winding down

With the invasion over, radar equipment across the UK began to be wound down and by November 1947 Ventnor was one of only twenty-six stations still operational. That month, a Channel Islands mail plane crashed into one of the 240ft receiver towers and the remaining section of the tower was later demolished.

Ventnor was subsequently chosen as one of the sites for the postwar ROTOR radar system, and most of the World War II buildings were taken down during the 1950s. Once the ROTOR station closed towards the end of the decade, the RAF moved out in 1961. Part of the site was taken over in 1962 by the Civil Aviation Authority.

The central compound was (at least in 2014) in use by air traffic control, with telecoms masts owned by other companies also on site. Those parts of the site remaining in use were very clearly signposted as not being open for us to explore!

There was still plenty to see however, including tower bases, a receiver building and a pillbox of a design peculiar to radar stations.

Needles Batteries

Once we had finished looking at the remains of radar activity at Ventnor, we walked back down (or were taxied by Steve Jewel who helpfully provided a one-man shuttle service) to meet the coach and travel to our second site of the day, the Needles Batteries.

Perhaps best known for views of the Needles Rocks, the site is on the westernmost tip of the Isle of Wight and its chalk cliffs are part of a band of chalk running right through the island and under the sea into Dorset. Here are sited the Old and New Batteries, the older of which was our first stop.



*The Old Battery was built to defend the Solent.
Photo Adrian Armishaw*

Constructed from 1861–63, the Old Battery formed part of the chain of defences protecting the naval dockyards at Portsmouth and was built on the orders of Lord Palmerston. Like other coastal fortifications which were developed amidst fears of a French invasion that never came, it is one of what were later termed – unfairly in my view – Palmerston's Follies.



*The tunnel leading to the searchlight emplacement.
Photo Adrian Armishaw*

The original armaments were replaced in 1873 by six Armstrong 9-inch rifled muzzle-loading guns, but these were soon considered obsolete and replaced by more powerful guns, the weight of which was considered too great for the existing battery, so in 1893 the New Battery was constructed.

The 1873 guns remained in place until 1903 when, with typical concern for conservation, they were simply thrown over the cliffside. In 1885 a tunnel was sunk from the parade ground towards the cliff face, with an elevator to the beach completed two years later.

The Old Battery also hosted early searchlight tests and there is a remaining tunnel leading to one of the searchlight emplacements. Two of the 9-inch Armstrong guns are on display today in their original positions, having been retrieved from their dumping ground.

The New Battery

Built higher up the cliff at 120 metres above sea level, by 1903 the New Battery housed three 9.2-inch Mark IV breech-loading guns. Each gun took a crew of eleven to fire a 380lb shell. Both Old and New Batteries were manned during the two World Wars and fired on German torpedo boats attempting night landings. In 1954 they were decommissioned and later taken on by the National Trust. Once we had explored the Old Battery there was time for refreshment in the 1940s-themed café before a short walk to the High Down Rocket Testing Site, a rare surviving example of a 1950s experimental rocket facility.

Picturesquely situated looking out over the Needles lighthouse towards Bournemouth, this site was originally built and operated in secret. We had the benefit of



Gunners run to their posts at a 9.2-inch coastal defence gun at the Needles New Battery on 7 August 1941. Photo from Imperial War Museum reproduced under creative commons licence



The underground magazines of the New Battery contain an exhibition about the secret rocket testing carried out on the a few hundred yards away in the 1950s and 60s. Photo Clive Holden

a National Trust guide, John Neale, who had close acquaintance with the site and the work done here, which takes in a good amount of the impressive history of British rocket and space technology. His father was an electrical engineer on the site, and so as a child he caught a glimpse of goings-on.

Rocket development at High Down

With its focus historically being about coast and countryside, the National Trust originally tore down much of the site in the 1970s before its importance in the industrial archaeology of the Cold War was recognised. The postwar arms race between the West and the Soviet Union was pivotal in the genesis of British rocket technology as the UK sought to keep up with ballistic missile advances in Russia and the USA.

The early work at High Down centred on the development of the *Black Knight* ballistic missile, a joint programme between the Royal Aircraft Establishment and a British manufacturer, Saunders-Roe, based at East Cowes. The rockets were mostly transported to Woomera in Australia after testing, and between 1958 and 1965 a total of 22 were launched (notably without major failure) before the programme came to an end.

Black Knight proved to be a successful first British expendable rocket project and the work led directly into the design of a launch vehicle known as *Black Arrow*.



Black Arrow rocket on the test stand at High Down

Black Arrow was developed as an expendable satellite launcher and in 1971 launched the satellite *Prospero*, also known as *X-3*. Designed to aid research into the effects of the space environment on communications equipment, *Prospero* was active until 1973 and has been periodically contacted since. Signals from the satellite were reportedly detectable in 2004 (BBC *Coast*) and it is expected that it will remain in orbit until at least 2070.



Much concrete from the test stands at High Down can still be seen. Photo Chris Brown

Despite the demolition of most of the site, we were able to walk around the remaining concrete structure and get an impression of just how vast the operation must have been at its peak. It is a shame that so little remains of what was a golden chapter in British engineering, although the small museum that the National Trust has provided tries to put High Down in its historic context.

Having spent a pleasant day on the Isle of Wight, we returned to the welcome comfort of our coach for a restful drive before the return hovercraft crossing. In the evening, the traditional Sub Brit trip dinner took place at Rees Hall, and fortunately the catering was above the standard of most student halls.

Day 2: the Forts

Fort Widley

Sunday was 'fort day' and began with a visit to Portsdown Hill and another of Palmerston's constructions, Fort Widley. Built by William Tredwell in the 1860s, it was designed to protect Portsmouth against attack from the northern landward side and cost the equivalent of £10.3m in today's money.

Widley was one of five forts constructed for this purpose at Portsdown, with a military road facilitating communication between them. Initially equipped with similar armaments to the Needles Batteries, Fort Widley was disarmed in 1907 and used as barracks for infantry regiments through the years until World War II.

During World War I the site was a transit depot, and in World War II it served as a Royal Engineers Bomb Disposal Unit, a PoW camp and later an alternative control centre for HMS *Dryad* (nearby Southwick House, the HQ of Allied D-Day planning). In February 1952 the Civil Defence Committee of Portsmouth Borough Council selected the site for their emergency civil control centre and the main underground magazine and ground floor of the barrack block were redeveloped, opening in January 1955.

The Civil Defence Control went through various iterations, including Standby Country Control for Hampshire County in the event of Winchester being unavailable. It was closed down in 1992. Portsmouth City Council took ownership of the site in 1972 and in 1990 an equestrian centre was opened, from which strident instructions to the young riders could be heard emanating during our visit.



Members explore the Civil Defence Operations Room. Note the original barrel-vaulted magazine roof. The observation window from the controller's room on the upper level can be seen on the right. Photo Jason Holdcroft



Looking into the operations room from the controller's room above. Photo Jason Holdcroft

Surviving aspects

Fort Widley is a large and rambling complex and varies from almost perfect preservation in places to near dereliction in others. Apart from the Equestrian Centre, other parts are also off-limits for visitors.

In September 2010 part of the site was used for an International Rescue Corps simulated earthquake exercise, and some of the underground areas remain sealed off for use by emergency services for training. Rooms in the barrack block are all in use for other purposes (one was full of canoes), but we were able to have a quick walk-through.

The rooms of the civil defence operations centre have been left largely intact, with some displays constructed to give an impression of what things may have looked like in action. The control room has desks set out for signallers, telephone operators etc. The curved acrylic glass window overlooking the operations area and its wall maps survives. A variety of artefacts such as texts on permissible doses of radiation adds interest.



Looking northwest along the tunnel to the western caponier at Fort Widley from the bottom of the spiral staircase. Photo Adrian Armishaw

Photo Adrian Armishaw

Externally there is much to see. The present lessee, the Peter Ashley Activity Centres Trust, is trying to open



up more of the site, subject to gaining the necessary permissions. In order to manage vegetation a small herd of goats has free rein inside the fort walls, and we saw them during our visit.

Emerging into the daylight on the grassed parade ground of the fort, we saw how the site is being put to a variety of new uses. As well as a quantity of telecommunications equipment, the riding school and a motley collection of vintage ambulances could be found. Also in residence were several caravans from the Caravan Club, with their owners sunbathing outside, marking one of the few occasions when Sub Brit members have emerged from underground to find we are not the most unexpected sight.

Fort Nelson, Fort Southwick, and home

Fort Widley was followed by lunch and a few hours at Fort Nelson, opened as a tourist attraction by the Leeds-based Royal Armouries ('home of the Big Guns'), where we were able to watch the firing of some vintage weapons from various eras.

Fort Nelson and our final site of the weekend, Fort Southwick, have both been visited and described elsewhere (Fort Southwick in *Subterranea* 44, April 2017) and so I will not describe them further here. Other Portsdown Hill forts appeared in *Subterranea* 43, December 2016.

It remains only to thank those involved in organising what was a fascinating weekend exploring the Isle of Wight and the subterranean history of the defence of our naval headquarters, with special thanks to Alistair Graham Kerr who led the trip.

Anybody travelling near Portsmouth would do well to take a look at the subterranean and surface archaeology



*A vintage gun being fired at Fort Nelson.
Photo Gerald Tompsett*

of the area, and to make a short trip over the Solent to take in what the Isle of Wight has to offer.

Sources:

This article draws heavily upon the trip guide booklet produced by Alistair Graham Kerr, which in turn uses material from the *Subterranea Britannica* website by Nick Catford and others.

Hovercraft information from wikipedia and www.hovertravel.co.uk

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*One of the large tunnels in the underground combined headquarters at Fort Southwick.
Photo Adrian Armishaw*

The Barons' Cave in war and peace, Reigate, Surrey

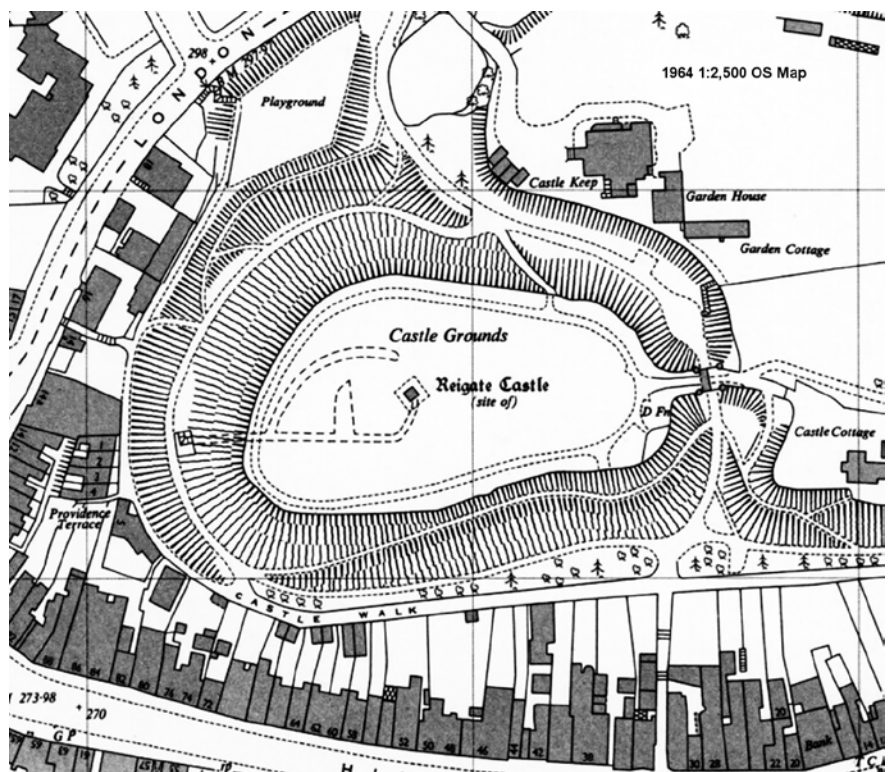
Paul W. Sowan



Looking south-west along the curved gallery. Shallow steps lead up to the main east - west gallery

The so-called Barons' Cave, excavated below the earthworks of the former Norman castle in the centre of Reigate, is thought to be an original feature of the twelfth-century structure. Although no original masonry remains in place above ground, the defences comprising a truncated length of a wet moat still in water and a further length of dry moat may still be seen. These survive as impressive features within what is now a public park.

The southern defence consists of a steep sculpted slope overlooking the backs of premises along the north side of the High Street (a number of which properties have rock-cut cellars dug into the lower parts of the slope). The entire sculpted and tunnelled hill is of the Folkestone



Sand bed within the Lower Greensand strata (Lower Cretaceous).

The first known description of the Barons' Cave appeared in *Britannia*, a printed book written by the noted antiquary William Camden [1551–1623], first published (in Latin) in 1586. A modern translation of Camden's text reads ...

On the east side [of the town] stood a castle, now neglected and decaying with age, built by the same earls [of Warren and Surrey], and commonly called Holmes castle from the vale in which it stands. Under it I saw an extraordinary passage with a vaulted roof hewn with great labour out of the soft stone of which the hill is composed.

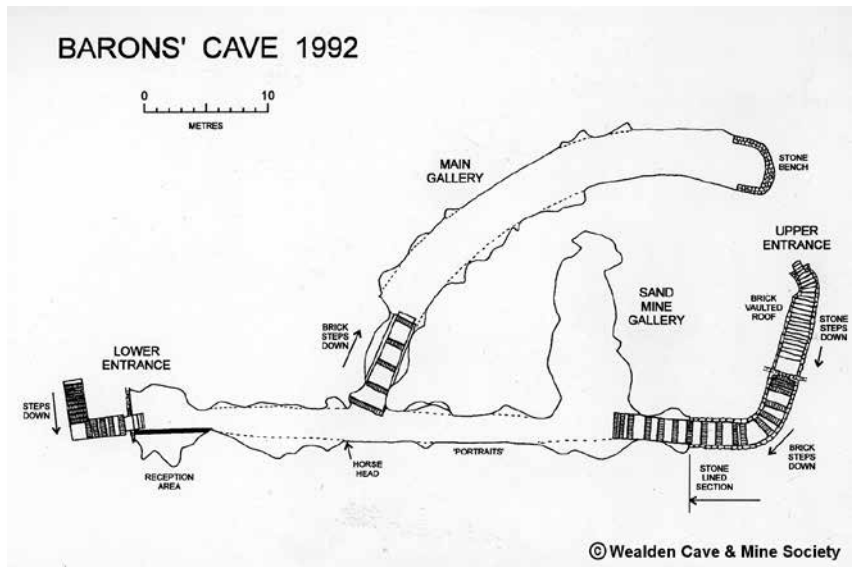
The 'Barons' name (not used by Camden) supposedly reflects the use of this underground space by the rebellious barons composing Magna Carta, signed by King John in 1215. However, it is now generally believed that this story is a later invention of an over-imaginative cave guide! The 'barons' were first mentioned in connection with the 'cave' in the first edition of *On the new state of England*, a book by Swiss-born Guy Miège [1644–(?) 1718] published in 1691. He wrote ...

[Rigate. Rygate, or Reygate, a noted Town for the successful Battles fought there against the Danes, stands in a Vale called Holmes Dale. From whence is sent up to London, for the Clothiers Use, abundance of Fullers Earth, excellent in its kind. This Town shews still the Ruins of an ancient Castle, with a long Vault under Ground, and a Room at the end of it, where 'tis said the Barons met in Council in their War against King John (page 110)]

This might well be an embroidered and reworded quotation from Camden. For much of the last four or five centuries the 'cave' has been one of the town's best-known tourist attractions, becoming especially widely known after the establishment of Brighton as seaside resort in the 18th /19th centuries: the original stage-coach road to Brighton (now the A217) ran through the town, the inns of which were a popular place for lunch, changing horses, or overnight stops. Many of the names and dates (1644 onwards) incised on the sandstone cave walls are probably the work of visiting tourists.

Descriptions of the 'cave': one entrance or two?

The 'cave', now, has two entrances. The upper one, not now in use, is below a small stone-built pyramid standing in the lawn at the centre of the sometime inner bailey. The lower and now main entrance is down a flight of steps from the floor of the dry moat. These are linked by a carefully cut tunnel with a Gothic arch ceiling profile, the eastern end of which ascends via a flight of steps to a grille at the top entrance.



The upper entrance

A short way in from the lower entrance, on the north side, a short flight of steps leads down to an impressively spacious curved chamber at the far end of which is a blank wall. Also on the north side of the through passage, towards the upper entrance, is a small side chamber, very crudely hacked out and quite out of character with the carefully sculpted remainder of the cave. Apart from the uppermost part of the steps up to the upper entrance, the cave walls are unlined natural in situ sandstone.

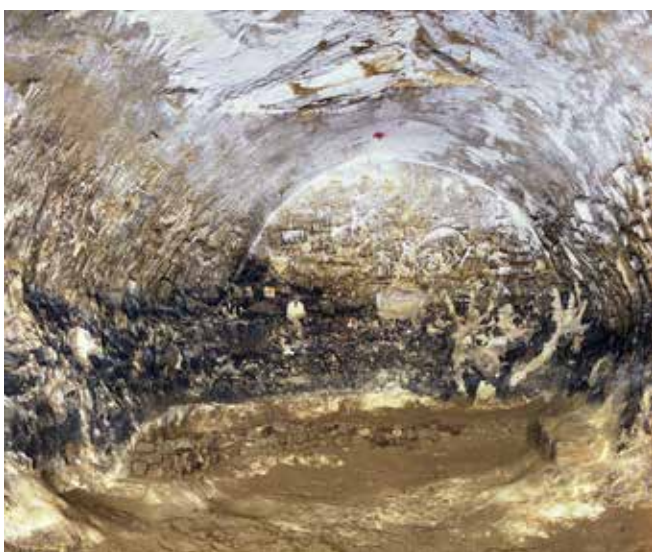
Numerous descriptions of the 'cave' and plans and drawings, both from first-hand observation and 'recycled' from earlier works, have been published since Camden, a number of the published plans being quite obviously grossly inaccurate. Some descriptions seem to imply that the through passage formerly terminated in a circular 'room' at a dead end.

Some authors have postulated that the passage continued under the floor of the dry moat and under London Road to an exit at a former market place at West Street – such a continuation would have passed below the moat at a remarkably shallow depth. The most likely scenario is that there never was a continuation, and that there was either a dead end at this point, or there was always a lower entrance.





The curved chamber close to the lower entrance



The blank wall at the end of the curved chamber

How was the spoil removed?

Whether or not the lower entrance has always existed, or is a relatively modern feature, is a significant factor in considering how the cave was excavated. If the entire contents of sand had to be removed via the top entrance, many tons of sand would have been lifted from the huge main chamber up the steps to the main passage and, with the addition of that excavated from there, up the further steps to the top entrance.

If on the other had the cave was made by tunnelling in from just below the present level of the dry moat floor, much (but by no means all) of the sand would have been lowered downwards, assisted by gravity. Exactly how the original floor level of the dry moat (which has presumably silted up to a degree) is related to the cave floor level is not known.

There is also the question of how and where this considerable volume of sand was disposed of. Wilfrid Hooper [1882–1950] in his book *Reigate: its story through the ages* (published by the Surrey Archaeological Society in 1945) suggested that sand excavated to form the dry moat was thrown up ‘on to the inner area so as



A number of dates are carved into the wall of the curved chamber. 1799 is clearly seen here

to make a broad and lofty motte or mound’. Presumably, had he considered the destination of sand taken to form the cave, he would have suggested the same means of disposal. This seems improbable.

Loose sand thrown up (apart from being very hard work) seems hardly likely to have made for stable foundations for the former curtain wall and angle towers known (from a crudely executed drawing published in the second half of the 18th century) to have existed. The entire castle mound is most likely to have been sculpted by the removal of in situ rock, rather than augmented as described.

One significant fact can be ascertained from the several published plans of the cave. The earlier ones do not show the roughly hewn so-called ‘guard chamber’ on the north side of and part way up the through passage towards the upper entrance. This seems to have been a nineteenth-century addition, perhaps dug simply for a supply of sand. The name ‘guard chamber’ is probably another cave guide invention!

Purpose of the ‘cave’

Theories of the cave’s original purpose abound. Some of the suggestions (such as for example a sally port) depend on there having been two entrances from the outset. The interior of the main chamber is remarkably clean, with little if any soot such as might have accumulated from candles or oil lamps or similar, making the ‘banqueting hall’ theory unlikely.

If a dungeon, it is extraordinarily large! Presumably the only people generally worth imprisoning would be high-value hostages the release of which could be bargained for. Peter Burgess’ identification of the large lowest space as a wine and provisions cellar seems most convincing.

Undermining

Many years after Camden, extensive sand-mining took place underneath both the eastern and the western ends of Reigate Castle. At the western end, these mines for silver sand, entered from near London Road, passed below parts of the Barons’ Cave, with in places less than a metre of sandstone vertically between the two excavations.



Looking west towards the lower entrance. The opening to the curved passage is seen on the right. Both the lower entrance and the upper entrance were sealed when this photograph was taken. Access to the Barons Cave was through a hole in the floor and down into a sand mine gallery below the level of the cave.

This mining is thought to have commenced in the later nineteenth century, following the opening of a turnpike road (now A217) up Reigate Hill to London via Sutton – most of the mined sand appears to have been sent to Thameside glass-furnaces.



Looking east along the main gallery towards the steps to the upper entrance. The roof has been carved to a precise Norman arch profile

Public ownership

Since 1873 the Castle grounds have been managed as a public open space, initially by the Borough of Reigate, and since 1974 by Reigate & Banstead. The site (including the ‘cave’, had been Scheduled as an Ancient Monument by the time war was declared in 1939.

World War II air-raid shelter

In the years leading to the declaration of war on 3 September 1939, the Borough of Reigate, in common with local authorities in general, gave much consideration to air-raid precautions (ARP). There had been some

bombing from German airships and aeroplanes during the 1914–18 war, and more was expected. In Reigate and its sister town Redhill, consideration was given to the provision of more or less bomb-proof shelters, and during the years to 1945 considerable numbers of these were constructed including converted basements and cellars, cut-and-cover trench shelters, and built brick and concrete surface shelters.

Reigate was especially fortunate in having a number of abandoned sand-mines in and around the town centre, as well as some rock-cut cellars, numbers of which were adapted for sheltering. Amongst these was the Barons’ Cave in the Castle Grounds, which served primarily for the use of children and their teachers at the Reigate Parish Church Boys’ School.

This establishment, for junior boys, stood on the west side of London Road (nowhere near the Parish Church at the other end of the town). Outside school hours the shelter was also available to public use. Shelterers from the school reached the lower entrance by crossing London Road (probably safer in the 1940s than it is today) and ascending a flight of steps into the west end of the Castle Grounds. The upper entrance served as the required emergency exit.

Electric lighting may have been fitted, but plumbed-in water and sanitation was certainly not. Presumably ‘Elsan’ style toilets and timber and canvas ‘modesty screens’ were provided, most likely in the so-called ‘guard chamber’ part-way up the steps to the top entrance. At this time the sand mine tunnels underneath were accessed from the premises of Alfred P. Phillips, listed in Kelly’s street directory for Reigate for 1942 as a ‘general engineer’ in ‘Knight & Gealer’s Building’ at 14 London Road.

Problems with access

In or about May 1941 it was reported that a part of the shelter floor, a few yards in from the lower entrance, had collapsed into the old mine gallery below, constituting an obvious hazard to shelterers. This difficulty was overcome by bridging the cavity with two 27ft-long RSJ beams, corrugated iron sheets, and a reinforced concrete slab. Surplus sand was dumped in the ‘cave below’; this part of which was evidently not then in use. The estimated cost was £60 which, at 1941 prices, was a considerable sum. During the remedial works, children and others had to access the shelter by the upper entrance, a longer uphill walk.

By August 1941 Messrs Friary, Holroyd & Healy’s Breweries Ltd of Guildford had evidently acquired an interest in the lower-level tunnels for storage purposes, and in May 1942 communicated with George Sanderson, the Borough Surveyor & Engineer, to express unease on the part of HM Customs & Excise concerning the security of their space used, or proposed to be used, as a bonded store. They were assured that the hole in the floor had been sealed.





The collapse in the floor of Barons Cave looking down into the Auction Room mine below in May 1987



Looking up from Auction Room mine into Barons Cave in May 1987

In December 1943 the brewery wrote again, to complain that since the hole in the floor had been sealed, air circulation and quality in their store had deteriorated. It was proposed that a cast-iron ventilation pipe should be installed from the brewery's store via the Barons' Cave to the ground surface above. This pipe, with the date 1942 cast on one side, was duly installed, and remains in position in 2017 although the mine underneath has since been backfilled (in the later 1980s).

After the war

After the war the 'cave' was again accessible to visitors. The author's first visit was occasioned by responding to a notice board in the grounds to the effect that access could be had on payment to the park-keeper of an admission charge of three (pre-decimal) pence. This resulted in a personal guided tour, the cave being lit so far as I remember by a torch or an oil lantern.

Later, the Council 'permanently' closed and sealed the 'cave', unaware that a great many people were continuing to gain entry via the then abandoned lower-level mine tunnels which had unrestricted access from the site of

demolished buildings facing London Road. Another hole had appeared in the 'cave' floor, close to the slab which had sealed the earlier collapse. This route in was lost during the 1980s backfilling.



Carved portraits are seen in several places in the cave

Wealden Cave & Mine Society reopens the Barons' Cave

Most recently (from about 1988) the Wealden Cave & Mine Society has, in collaboration with Reigate & Banstead Borough Council, re-established guided public visits, one Saturday each month from May to September: see the website for details. Visitors are handed small electric lanterns, and the guide explains the salient features and recites what is known about the history of the site. The Society (www.wcms.org.uk) has published a booklet about the 'cave', and a set of three colour-printed picture postcards of interior views.

Acknowledgements

The author is a member of WCMS and one of the cave guides team. Information about the cave is in part from the published work of Peter Burgess and Malcolm Tadd, both of WCMS, with details about the wartime years from the Borough of Reigate's ARP files (2295/1) held at the Surrey History Centre at Woking.



Malcolm Tadd (former Sub Brit secretary) leads one of the WCMS tours

All photos Nick Catford

Gibraltar Study Tour, October 2017

Tim Wellburn



The ridge of Gibraltar, looking north. Lord Airey's Battery in the foreground and the former water catchment slope to the east.

Photo Clive Penfold

“The tour will be strenuous, involving long days with a great deal of walking, much of it uphill & down...”: so cautioned the announcement of Sub Brit’s 2017 Gibraltar Study Tour. It certainly delivered on this promise; by the end of the week’s exploration we had walked forty miles, not bad in a territory only about 3 miles long by a mile wide – and reaching 1,398 ft above sea level! We had also seen a remarkable variety of works and underground spaces, spanning the 18th to the 20th centuries, encompassing examples of almost everything necessary to withstand a siege.

The tour built on Sub Brit’s earlier visit in 2016, which was written up in *Subterranea* 42 (Sept 2016), so this account will focus largely on the sites not previously seen and recorded.

To accommodate expected demand whilst keeping the group size manageable, the 2017 tour ran in two parts over successive weeks, seeing the same sites on broadly similar itineraries. I led the first party; Clive Penfold kindly agreed to lead the second.

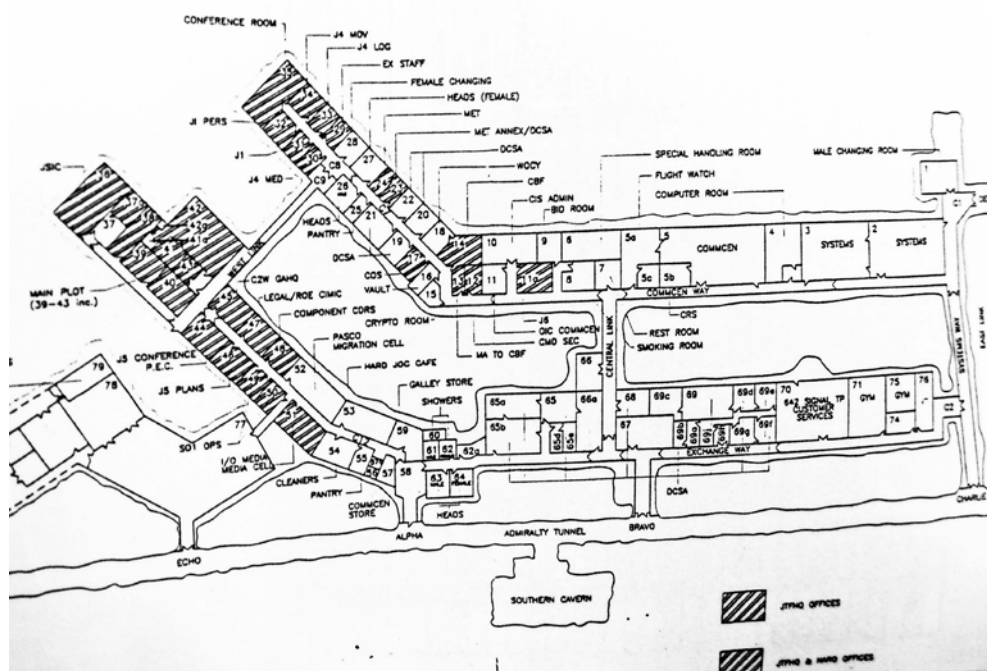
Like the RAF in 1940, we set up our HQ in the *Bristol Hotel* – in Victorian times the best in Gibraltar – but more recently described by one Sub Britter (somewhat kindly) as “a delightful fading lady of a hotel”; and here we gathered on the Sunday evening for a briefing on the week ahead before strolling along to Casements Square for a cheerful *alfresco* supper.

Admiralty Tunnel & ComCen

We started the tour on Monday morning with a statement of intent by walking from one side of the Rock to the other through a former railway tunnel. This was Admiralty Tunnel, which runs in a straight line from the Royal Naval Dockyard in the west to Sandy Bay in the east. It was built in 1898–99 to facilitate the transport of quarried stone to the major works being undertaken to develop the dockyard.

In consequence of unpropitious geology: a fracture zone, shale and the wind-blown uncemented red Alameda Sands which overlie the limestone of the western flank of the Rock, much of the tunnel had to be lined. Numerous





Plan of the NATO Joint Operations Centre

Gibraltar Museum & the Royal Engineers' model of The Rock

Emerging again into the sunlight, we walked back into town to orientate ourselves for the rest of the week's sites by visiting the excellent Gibraltar Museum and, in particular, by inspecting one of two extant models of The Rock produced by Lt. Charles Warren, RE.

These remarkable, highly detailed and enormous (25 ft long) models date from 1865. The museum's model is conserved in original condition. The other is still in military possession, at the Buffadero training ground, but has been progressively updated, so is less useful as a historical resource.

The surprisingly Tardis-like museum is highly recommended to any visitor to Gibraltar. Built on the site of the 14th-century Moorish Governor's Palace, it incorporates excavated Moorish baths and houses a wealth of artefacts.

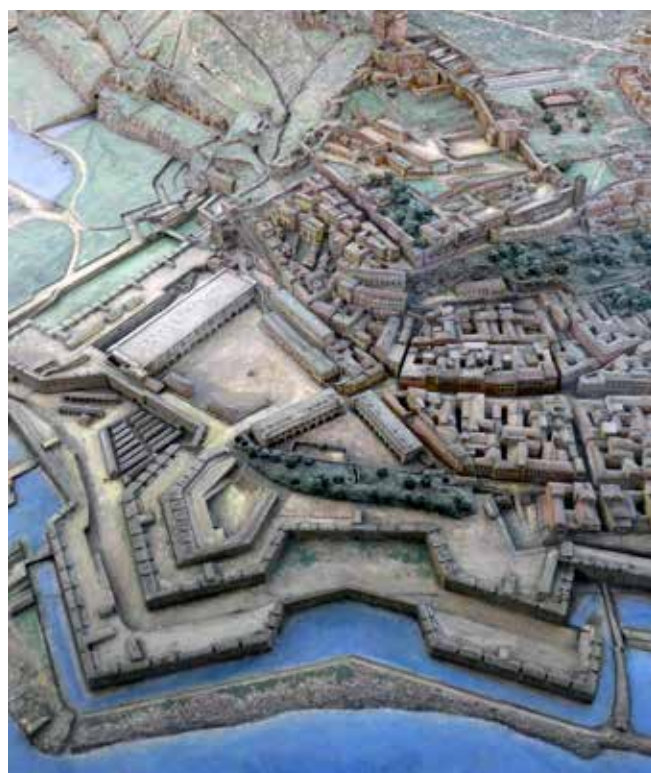


Admiralty Tunnel, the lined western end

pipes and cables of different vintages run along either side of it, particularly at the Dockyard end.

Unlike most long-disused rail tunnels, this one had a Second World War tri-Service Joint Operational Communications Centre (ComCen) constructed about one-third of the way along it. The site lies deep below Maida Vale at the junction of the Great North Road and Foss Way. The ComCen was used as the Allied Headquarters from which General Eisenhower planned *Operation Torch*, the November 1942 Anglo-American invasion of North Africa. His office had been restored as the "Eisenhower Room", set out as it was at that time.

Postwar, the facility was adapted to serve as a NATO Joint Operations Centre, being extended to some eighty rooms. It is now used by *Continent 8* as a secure data centre. Once again, we were kindly given access and shown around by Luis Garcia, General Manager, Gibraltar.



Part of the Royal Engineers' 1865 Model of The Rock. Casemates Square, the Grand Battery and Landport Gate are centre-left; Montague and Orange Bastions (and their respective counterguards) to seaward; and the Northern Defences, Castle Batteries and the Moorish Castle on the rising ground above the town

The Landport Front and Northern Defences

Taking advantage of being in town, we paused for lunch before meeting our good friend Carl Viagas to guide us on a return visit to the Northern Defences, a remarkable complex of largely 18th-century Lines and associated underground galleries. One of Carl's many projects is to deliver the Gibraltar Government's initiative to conserve and open up these immensely important, but hitherto neglected defence works.

He first took us from Casemates through the 1729 Landport Tunnel which leads under the Grand Battery to the Landport Gate with its drawbridge over the ditch, beyond which once lay the flooded area known as the Inundation. From here Carl was able to explain the geographical and historical context of the Northern Defences before we climbed up past the Castle Batteries to explore them.



The King's Lines, Northern Defences: Carl Viagas leading the first SB group. The blast walls protect entrances to King's Gallery, which runs parallel to the Lines

The King's Lines

We followed a route broadly similar to that taken in 2016, reaching the King's Lines via the Bombproof Battery (1790), abandoning daylight again to enter King's Gallery (1789) which runs immediately behind and parallel to the Lines. At its northern end the gallery opens onto Star Chamber and, just beyond it, St Patrick's Chamber (both 1790). On this occasion, as well as inspecting the fine WWII ranging diagrams in Commons Hall (1789), we also ventured down another tunnel which led to the very impressive two-storey casemate of Upper Orillon Battery, excavated where a natural fault opens into a ravine.



The Landport Tunnel, giving access to the Landport Gate

The Northern Defences were described at some length in *Subterranea* 42. Designed to give flanking fire across the Land Front they comprise a series of long parapeted *terrepleins* cut back into the rock face. In WWII they acquired various concrete accretions include pillboxes and blast walls protecting entries into the galleries. The galleries were constructed in the years immediately after the Great Siege, providing additional gun emplacements, shelters and – together with the “Communications” running across the slope of the Rock – protected links between the various defensive positions.



The two-storey casemate of Upper Orillon Battery, exploiting a natural fault



The Queen's Lines

Beyond St Patrick's Chamber lie the extensive Queen's Galleries and Lines. Those who had seen the Lines a year before were astonished at the further progress which had been made in clearing debris and vegetation, revealing a number of interesting features. We were able to inspect Lower Forbes' Battery (1761) with its two barrel-vaulted casemates, originally built for smooth-bore guns to flank the Queen's Lines but – as attested by surviving parts of a lamp installation – later adapted as a searchlight position. At the foot of this battery, now fully exposed, is a WWII brick and concrete gun position, with an anti-tank gun still emplaced.



The Queen's Lines: a WWII anti-tank gun emplaced at the foot of Lower Forbes' Battery

The Prince's Lines

From here we were able to access Upper Forbes' Battery, from which a flight of stone steps gained us the Prince's Lines and the cliff-edge Prince's Lines Battery where a further pair of Defence Electric Lights was recorded as being emplaced as early as 1896. A breathless clamber up a further, very long, flight of stone steps led us through a cleft in the rock to the vertiginous Forbes' Lookout. This provided us with a bird's-eye view of the airport – and the theatre of the closure of the road across the runway to allow a BA flight to land.

We returned to our starting point via the Prince's Lines, admiring the fine 18th-century Magazine and Bombproof Barracks; the short Prince's Gallery (1790) notable for the long underground hairpin-shaped gun ramp, Lower Prince's Gallery (also 1790), that leads

back down to Star Chamber; and finally Hanover Battery, with its magazine built into the rock face.

Just past the battery is an important route junction. The short tunnel of Castle Communication once linked to the barracks in Moorish Castle, whilst Lower Union Communication leads down to the King's Lines, and up to Lower Union Gallery, Upper Union Communication and thence Upper Union Gallery. Iron rings embedded in the side of these Communications facilitated gun haulage. Time had run out, so on this occasion we did not ascend further.

Windsor/Upper Galleries ("The Great Siege Tunnels")

A stiffish climb from Casemates next morning took us above the Northern Defences to the Upper Galleries (popularly known as the "Great Siege Tunnels"), one of Gibraltar's iconic defence works. These commenced with Windsor Gallery (1782–83), Sergeant Major Ince's radical initiative during the Great Siege of 1779–83 to tunnel through the north face of The Rock to mount a gun able to fire down on the Spanish lines from the commanding heights of "The Notch".



Plan of the Upper Galleries, as completed after the Great Siege (Gibraltar Heritage Trust)

The galleries are open to the public, but are not to be scorned. Indeed, since our last visit, access has been opened to the interesting Cornwallis Chamber. This battery lies below the level of the main galleries and was served by an internal slate-roofed magazine designed to protect the powder from water ingress as well as enemy fire: a surviving 18th-century precursor of the WWII magazines found elsewhere in Gibraltar's tunnel systems.



Cornwallis Chamber: one of two gun positions – both modified in WWII – with a reproduction Koehler Depressing Carriage (1782) which enabled the British to fire on the Spanish lines at depression angles of between 20–70 degrees. Photo Clive Penfold

The siege ended before The Notch was reached. However, in driving Windsor Gallery, the tunnellers had cut a ventilation hole through the rock face to vent the blasting fumes and this was quickly utilised as an improvised 24-pounder gun position. Three more guns had been mounted in similar embrasures within the advancing gallery before hostilities ceased. After the end of the siege, the cavernous St George's Hall was excavated as a 7-gun battery within The Notch. Cornwallis Chamber was also excavated in this period. The galleries were further extended in 1907–08, with a long straight passage, the Holyland Tunnel (it heads east: a military joke), leading out to a position-finding cell and a fire-control post, both clinging precipitously to the edge of the cliff. In 1941, Farrington Raise, a flight of 366 steps, was driven up from a point near Clapham Junction (at Middle Galleries level) to link the Upper Galleries into the wider military tunnel system.

Hay's Level, Fordham's Accommodation and the Middle Galleries

Hay's Level and Fordham's Accommodation are a series of WWII galleries, storage and accommodation chambers excavated between 1940–43 by 178 Tunnelling Company RE with assistance from 4th Bn The Black Watch. Sub Brit visited these areas in 2016 and they are written up in *Subterranea* 42. Once again we were fortunate that Pete Jackson had agreed to give us a private tour, sharing with us his enthusiasm, sense of humour and encyclopaedic knowledge.



'Clapham Junction': the nodal point at the end of Liddell Union. Jock's Balcony opens to the right; ahead is Upper Union Gallery; and behind, Thompson's Raise leads down to Macfarlane's Gallery and the WWII complex within the foot of the Rock's north face. Photo Clive Penfold

Jock's Balcony, where Liddell Union unexpectedly breaks out into daylight, high above the airport, still worked its magic as a breathtaking lookout point across the isthmus to Spain. On this visit, we followed a route from the nodal point of Clapham Junction which took us back two centuries into the Middle Galleries: Queen's Gallery (1786) and Upper Union Gallery (1788).

These have numerous rock-cut casements which once emplaced guns firing out over the Queen's and Prince's Lines. Some still retain their original mantlet rails above the blocked-up embrasures. Many have been adapted for other uses, including a uniquely-sited position-finding cell, a kitchen, accommodation and other less apparent functions.

One casemate, which we examined without reaching any firm conclusion, revealed its identity in December 2017 when the *Gibraltar Chronicle* reported the discovery of a clandestine SOE wireless station in Queen's Gallery (this news was posted on the Sub Brit Forum). The galleries descend gently to open onto Upper Union Communication, the higher of the two covered ways which connect down to the Northern Defences which we had visited the previous day.



Queen's Gallery: SOE Wireless Station in an 18th-century Casemate

Willis's Magazine

Located on Willis's Plateau, a historic part of Gibraltar's northern front, this magazine is named for Captain Willis who made a significant contribution in the Twelfth Siege of Gibraltar (1704–05). Said to be the largest of its type remaining anywhere in the world, Willis's Magazine was steadily expanded and strengthened over the years. Records show expenditure of £16,647 on it between 1881–89 and, indeed, the present building is very different from that reproduced in the Royal Engineers' 1865 model.

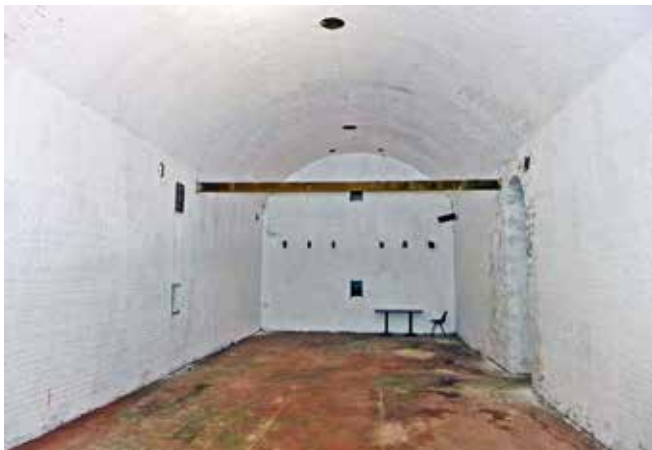
The magazine consists of four very large, interconnected chambers, the vaulted roof of which can be seen from outside. These chambers are sufficiently lofty to require to be lit from lighting corridors built on two levels within the thickness of the magazine's external walls. The protected main entrance is via a rock-cutting at the northern end, leading to a dog-legged access tunnel.





Willis's Magazine: the extensive vaulted roof; there was continuing concern about the site's vulnerability to Spanish shell fire

A shifting lobby, examining room, lamp room and coopeage are located to the south of the magazine block. The southern area of the site latterly has been used as a kennels.



Willis's Magazine: the most northerly of the four enormous bombproof chambers. The lamp windows of the twin-level lighting passages can be seen in the side and end walls

The first group met the appointed keyholder at the due time, only to find that somebody had damaged the lock. However, we managed to put the time to good use until the keyholder returned with official bolt cutters! We were grateful for this no-nonsense approach to facilitating our studies.

The Willis's Plateau 'Princess' Batteries

There are four batteries, all named after various princesses, situated on or adjacent to Willis's Plateau, and the first Sub Brit group went on to explore them before heading south to investigate Devil's Gap Battery. The second group's schedule omitted these in order to visit our 'extra' site during daylight hours. Two are worth noting here.

Princess Anne's Battery

Princess Anne's Battery is a group of four turreted 5.25-inch high-angle dual-purpose quick-firing (QF) guns, capable of operating in both an anti-aircraft and a coast defence role. These guns had been sought early in

1942, but other priorities meant they were not mounted until 1956. Each gun has its own semi-sunken engine/generator room which provided electrical and hydraulic power for traverse, elevation, ramming and other tasks. The guns had a rate of fire of ten rounds per minute and substantial ready-use ammunition lockers were built into the gun pits. The battery was operational until the 1980s and is now a unique survivor.



Princess Anne's Battery: three of the four 5.25-inch QF guns. The Mk1B turret mountings reflect their coast defence role

Princess Royal's Battery

Princess Royal's Battery site is derelict and quite difficult to read due to successive changes in armament (all long gone): Victorian 64-pdr rifled muzzle loaders (RML); two short-lived 6-inch breech loading (BL) guns; and, in WWII, a 40mm Bofors anti-aircraft gun. The battery has various ancillary works, including an underground magazine and crew shelter, accessible through the brambles, with a once-fine Royal Artillery crest painted on the wall. Sadly, all is now smoke damaged.

Devil's Gap Battery

Devil's Gap Battery is a 6-inch coastal defence and examination battery, with both its guns still emplaced and with well-preserved underground works. The battery was visited in 2016 and is described in *Subterranea* 42.



Devil's Gap Battery: the gorge of the southern of the two 6-inch guns, showing the rustic brickwork intended to disguise the battery's profile

Wednesday: the City Council Reservoirs

While still intimately concerned with The Rock's resilience, our first visit on Wednesday morning abandoned the military for the civil: the City Council's underground water reservoirs. This visit was kindly hosted and led by Chris Gomez, one of the Directors of AquaGib, Gibraltar's semi-privatised water utility company. However, there was no remission from hill-climbing: the reservoirs are located above the Tower of Homage, some 400 ft above sea level.



Chris Gomez welcomes Sub Brit to AquaGib. An entrance to one of the original late 19th-century reservoirs is on the left. Photo Clive Penfold

As we entered the site two things generated immediate interest: a disused narrow-gauge railway track laid in the approach road, and a row of four locked huts, clearly the access points to underground reservoirs. In fact, these were the first set, dating from 1898–1900 (designated nos.1–4), now used as supply reservoirs. Each chamber is 200 x 20 x 50ft, with a collective capacity of five million gallons. Originally, they were fed with rainwater from a catchment area on the north western slopes, ducted via open channels and pipes.

As the population and demand for water increased, further sources were required and an additional catchment area was constructed on the east side of The Rock, connected to the existing reservoirs by a 875-yard tunnel, the portal of which bears the date 1903.

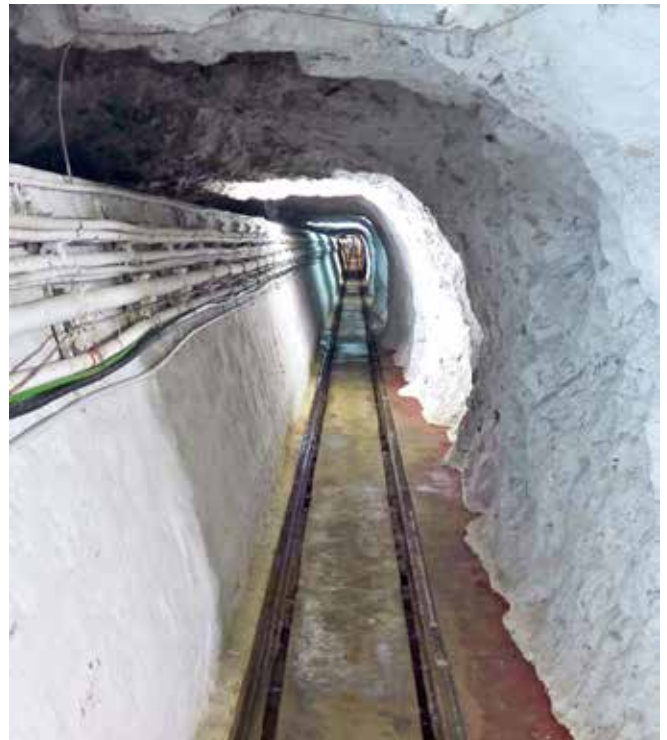
Between 1911–14 the No.5 reservoir, of two million gallons capacity, was excavated by means of enlarging a tunnel driven parallel to the water supply tunnel and some 25ft below it, to create a chamber 400 x 43 x 40ft. The walls and floor were sealed with cement. The catchment area was subsequently extended and, in 1928, No.6 reservoir was constructed. Structurally, this was similar to No.5, but only half its length and capacity.

Between 1933–39 four more reservoirs (nos.7-10) were excavated, potentially adding a further four million gallons storage capacity. Reservoir No.10, which had been excavated but not completed by the outbreak of WWII, was used to provide rather unsatisfactory and

short-lived protected barracks for a detachment of the Black Watch regiment.



Entrance to the 1903 water supply tunnel and later reservoirs. Photo Clive Penfold



The water supply tunnel looking east: the original supply conduit is on the left; the new reservoirs built from 1911 are to the right

We were able to visit Reservoir No.8 (1936; one million gallons capacity), which first entailed a long walk down the water supply tunnel. This was rock-cut – and whitewashed! The railway track runs into and along the length of this tunnel. The entrance is covered by a WWII pillbox inscribed 4th Bn The Black Watch, 1940–43. The tunnel still incorporates the conduit from the catchment area (which was abandoned only in 1993) leaving little by way of track clearance. No.8 Reservoir was visited by H.M. The Queen in May 1954, an event recorded in the Visitors' Book. This accounted for the elegant but somewhat incongruous stone balustrade which runs the length of the reservoir.



Reservoir No.8 (1936): the reservoir chamber is to the right, below the level of the balustrade

Parson's Lodge Battery

After another civilised lunch-break back in Casemates Square, the afternoon reverted to military affairs. Parson's Lodge Battery, sometimes misdescribed as a fort on account of its appearance, is an imposing stone structure built on top of a rocky promontory commanding the entrance to Rosia Bay, the only natural harbour in Gibraltar and therefore a site of great strategic importance.



Parson's Lodge Battery. The tunnel to the right was originally a railway tunnel

The Moors, Spanish and British had all built defences here. HMS *Victory*, with Nelson's body aboard, was towed into Rosia Bay after the Battle of Trafalgar. The Royal Navy constructed a large Victualling Yard here, completed in 1812. This very important historic building is largely extant but has been given over to a kennels and is in a shameful state of neglect.

The Battery's armament was steadily upgraded, notably in 1842 when eight guns were emplaced on the *terreplein* as a result of Major General John Jones' 1840–41 visit to inspect the defences of Gibraltar, and again in 1872, following Colonel William Jervois' 1868 Report, when three 18-ton 10-inch RMLs were installed.

These Woolwich guns fired a 400 lb shell up to 4,500 yards and were mounted in open embrasures behind shields constructed of a sandwich of armour plate and teak, known as "Gibraltar Shields". They remained in service until 1891 when they were superseded by 9.2-inch BL guns emplaced in new batteries located elsewhere.

Parson's Lodge then became a coast artillery searchlight position with its own generating facility. The searchlights were 90 cm, 200 million candlepower lights capable of projecting a focused 'pencil' (3 degree) beam up to 5,000 yards. Infantry and artillery returned in the First and Second World Wars and a further spate



*Parson's Lodge: one of the three 18-ton 10-inch RMLs.
The Sub Brit group seems to be studying
the RN Victualling Yard below*

of building was undertaken in 1941 by 2nd Bn Somerset Light Infantry, to accommodate anti-tank guns and anti-aircraft guns and searchlights.

The Battery, which is not publicly open, is in the care of the Gibraltar Museum. We were shown around by their very enthusiastic and knowledgeable senior guide, Phil Smith – a former soldier and therefore universally known as Smudge.

The Napier of Magdala Battery (“The 100 Ton Gun”)

We concluded the day by visiting Gibraltar’s “100 ton” gun: one of only two surviving 17.72 inch RMLs – the biggest guns of their type ever built. Propelled by a 450 lb black powder cartridge, its one-ton shell could penetrate 15 inches of wrought-iron armour at a range of three miles.

The British Government reluctantly purchased and installed two of these guns in Malta and two in Gibraltar in the early 1880s to counter the Italian Navy which had commissioned the (450mm) prototype from W. G. Armstrong and installed them in two radical new twin-turret *Duilio* class battleships.



*The 100-Ton Gun: the ultimate RML. By the time it was
installed in 1883 its successor, the 9.2-inch BL,
was already in production*

The land-based guns required a crew of up to 35 men, including the ammunition handlers, but were so large

and heavy that the entire loading cycle and gun laying process had to be mechanised, using a steam engine and hydraulic power, with a barrel wash-out between rounds. The rate of fire was only one round every 4–6 minutes.

Specialised emplacements were designed to accommodate the gun and its associated machinery, magazine and shell store. The gun was mounted *en barbette* in the centre of the battery. To either side of it was an armoured loading turret from which the cartridge and shell were loaded into the depressed muzzle of the gun by a hydraulic ram. A casemate accommodated the steam engine and hydraulic cylinder, the latter set in a pit in the floor.

A small underground passageway running laterally in front of the gun gave access to the loading turrets and linked the facilities on either side of the emplacement. The hydraulic ram chambers were accessed separately by a small staircase on each side.

At a lower level, running laterally behind the gun, were a shell store, in the form of a long shallow pit with an overhead traveller; and immediately behind it, a cartridge store and lighting passage.

On either side of these, running fore-and-aft, and making an ‘H’ configuration with the magazines, was a long handling chamber. These were laid with narrow-gauge tracks for loading trolleys, serving the cartridge store hatches and shell pit, and running forward to a hydraulic ammunition lift which served the armoured loading turret.

It was disappointing that the site supervisor was unable to provide us with the requested enhanced access to the underground areas, although as these appeared to be used for storage they were probably not very edifying. Malta’s 100-ton gun at the Rinella Battery is presented better and is now a popular tourist attraction.

We concluded Wednesday with a very cheerful group meal, taking advantage of our planned early finish within a short bus ride of town.

Thursday: the Great North Road & Calpe Hole

On Thursday, the first Sub Brit group headed off for a transit of the Great North Road, but the schedule for the second group had to switch this round with St Michael’s Cave, requiring a cable-car ride to the Upper Rock. A small ‘planning gap’ manifested itself when it was discovered that the cable car does not wake up before 09:30. Our guide, Steve Payne, nobly came to the rescue. These sites were described in *Subterranea* 42 so will only be touched on here. The Great North Road is a lorry-size spinal tunnel running from Calpe Hole, which lies to the east of the town centre, to Maida Vale, a point adjacent to the Old Casino, roughly half way down the length of The Rock.

Steve led us on our exploration, entering the tunnel system at Maida Vale where the Great North Road and Foss Way meet, the latter continuing the vehicular

route in a southeasterly direction. The experience was a little different this time in that the lighting was mostly working, which made it easier to see what we were visiting, but those with an affinity for the dark may have regretted some loss of ‘atmosphere’.



The Great North Road: Steve Payne briefs the group in the vast bay excavated alongside the roadway south of Peterborough Chambers

Still in darkness, Calpe Hole Generating Station remains awesome in its scale and in particular for its enormous engines (three English Electric Fullagar double-acting diesels and a Ruston gas turbine) and associated generating equipment. It is fortunate that an initiative to scrap this plant came to naught. The facility provided back-up power to the military from 1956 to 1972. Steve pointed out the concrete fire escape tunnels leading from the engine room, which we had not noticed on our previous visit.



Calpe Hospital: the operating suite

At Calpe Military Hospital we had more time to understand the complex layout, including identifying the officers’ and other ranks’ wards, and the rather sinister white-tiled operating suite. We also had time to ascend the long flights of concrete steps which lead up to Fordham’s Accommodation, where we could peer through the locked gate at the point we had reached on our visit on Tuesday.

Lord Airey’s & O’Hara’s Batteries

On Thursday afternoon, both groups reached virtually the highest point of The Rock, to visit two more military icons. The first of these was Lord Airey’s & O’Hara’s Batteries. Spectacularly located on the southern extremity of the ridge, over 1300 ft above sea level, these 9.2-inch BL guns were last fired in 1976 and remain extant, complete with their related underground works.

The first guns mounted here were 6-inch BLs in 1890, but the new 9.2-inch BL guns had replaced them by the end of the century. A subsequent upgrade of barrels and mountings increased their range from 14,000 to 29,000 yards. Originally these guns were mounted *en barbette*, without crew protection, but in 1934 open-backed protective shields were fitted, giving the installations the appearance of turrets.



O’Hara’s Battery: the 9.2-inch BL gun breech.
Photo Clive Penfold



O’Hara’s Battery: the shell hoist



The shared engine room of O'Hara's and Lord Airey's Batteries. Photo Clive Penfold

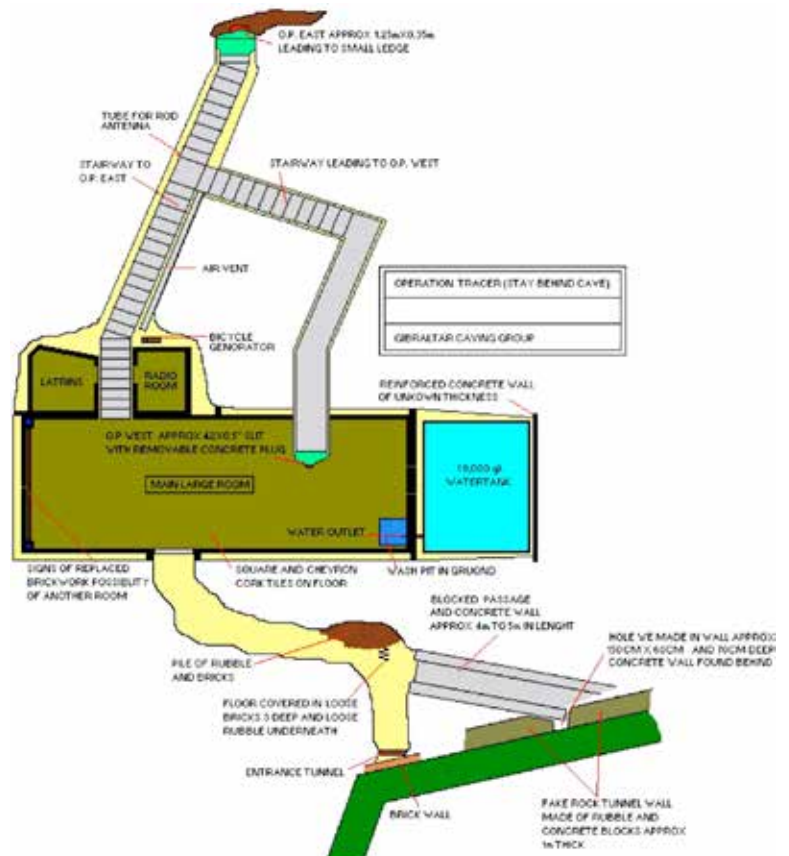
The two batteries shared an underground engine room designed to accommodate two 10.5 bhp oil engines (only one large engine is now installed). Each had a crew shelter and, located under the gun emplacement, an underground magazine and shell store, connected to the engine room by rock-cut tunnels. The engine room and O'Hara's magazines have been restored and are well lit; those at Lord Airey's are dark and neglected: an interesting contrast in atmosphere!

Operation Tracer: 'The Stay-Behind Cave'

A site adjacent to the crew shelter for Lord Airey's Battery was the location chosen for the construction of the "Stay Behind Cave". Only relatively few visitors are allowed inside this exceptional and very fragile space, and we were privileged that Gibraltar Museum had agreed to give us access. Our friend Smudge duly arrived to guide us. It is also quite a confined space, so we split into smaller groups, alternating visits with the gun batteries.

A little history

In the summer of 1941, Rear Admiral John Henry Godfrey, Director of the Admiralty's Naval Intelligence Division (NID), decided to establish at Gibraltar (and possibly elsewhere) one or



Operation Tracer: plan of the facility, drawn by Mark Ainsworth, one of its discoverers, and reproduced with his permission



more covert observation posts which would become operational if the territory were to fall into enemy hands. The scheme was given the code name *Operation Tracer*. From such posts military personnel, sealed inside, would be able to monitor enemy movements, reporting back to NID by radio.

Initial plans provided for accommodation, water, sanitation and wireless communication, with a year's rations for five men. The scheme was later changed to one which would support six men with provisions for up to seven years. The psychological impact of such an extended confinement must have been assessed, but can only be wondered at.

Construction commenced in secret in late December 1941; on completion, all those involved were immediately returned to England. Meanwhile, the *Tracer* team had been selected, trained and posted to Gibraltar, under the security cover of various 'day jobs'.

Into the abode of heroes

We followed Smudge into the crew shelter, and beyond it into a long passage lined with rusting corrugated iron. Near a bend in the passage this lining had been removed at two points to reveal, first, the blocked excavation access to the 'Stay Behind' facility, and just beyond this, the small, still partially bricked-up operational entrance hole. This opened onto a short rock-cut tunnel which still contained a pile of bricks for the six men sealed inside the cave to further close off access, and a heap of soil, to facilitate any subsequent burials.

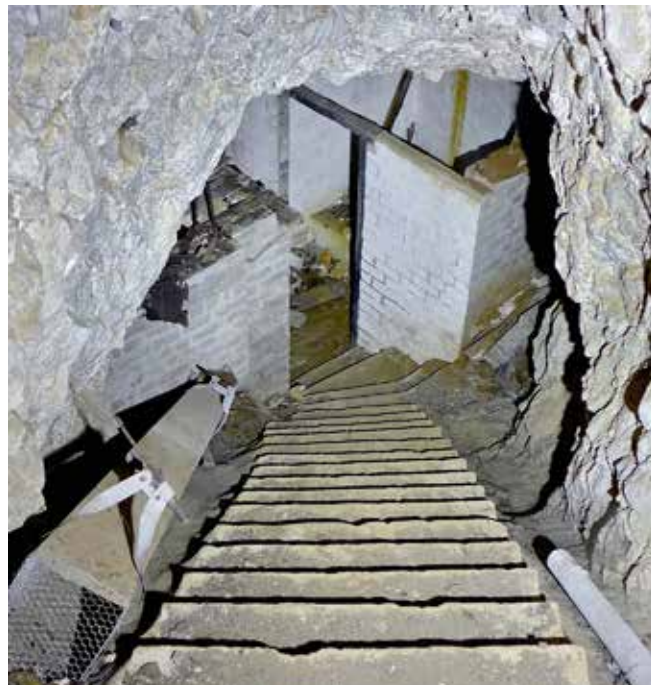
Under operational conditions, this entrance area would also have been closed off at the inner end by the doorway to the living quarters (which doubled as a storage area), a chamber 45 x 16 x 8ft. To reduce noise, this room had been plastered, and the floor laid with cork tiles, now much decomposed. At the far end was a water outlet, supplied by a 10,000 gallon tank located behind the wall.



Operation Tracer: the living quarters; the water tank was behind the end wall

Across the room, another doorway gave onto some steps, to the left of which lay a double lavatory (unbelievably vandalised), and to the right the small radio room which

once housed a Mk 3 transmitter and National HRO Receiver. Three 12-volt, 120-amp batteries would have been charged with either of two generators, one bicycle-driven, the other hand-cranked. The bicycle, which also drove a ventilation system, had had its chain replaced with a leather strap, in order to minimise operating noise. This is now in safe-keeping (but not on display!) in the Gibraltar Museum.



Operation Tracer: looking down the main flight of stairs to the WC and radio room. The aerial storage tube is on the right of the steps

Beyond here, a stairway leads directly up to the eastern observation position. This gives access onto a small concealed external ledge, providing some fresh air and sunshine. A tube running up the stairway housed an 18ft rod aerial which could be deployed through the eastern OP. From a landing halfway up, another stairway leads up to a passage running back to a small observation slit covering the western approaches. This, more exposed aperture, could be closed by a concrete wedge.

I am sure that everyone who visited this remarkable place will long remember it; indeed, some found it a quite moving experience.

Mediterranean Steps

The plan was to return from here by the famous Mediterranean Steps, a scenic path that descends precipitously past Fire Control Post No.4 and the Martin Group of position-finding cells, to emerge at Jews' Gate Battery. With their revised schedule, the second group achieved this. The first group had to hasten back via the cable car as we had another, unexpected, visit that evening.

Admiralty Wireless Station, Macfarlane's Gallery, Williams Way and 'Project C'

Over dinner with Carl Viagas earlier in the week, I had been telling him about two visits I had tried in vain to secure, both sites having been sold off for private

development. One of these was the WWII northeastern tunnel complex which included 'Project C', the RAF fuel storage tanks.

Carl remarked that he knew Tracy Lee, the owner of Gibraltar Wine Vaults, the company developing this area, and immediately offered to ask her whether she would allow us a visit. Not only did she do so, but generously rearranged her own diary that week to give the first Sub Brit group a personal two-hour evening tour. The invitation was also extended to the second group. With a bit of schedule rejigging we managed to fit this in as a daytime visit, which Carl very kindly led.

Admiralty Wireless Station: soon to be a defensible wine cellar

Having signed-in and donned high-viz and hard hats, we passed through a modest entrance at the foot of the cliff which opened onto a pair of large chambers, one of which contained a substantial water-filled pit, presumably a heat sump. Although the internal walls have now been stripped out, the complicated pattern of foundations and plinths marked this area as being the operational core of the former Admiralty Wireless Station (1940).



Macfarlane's Gallery: a surviving emplaced anti-tank gun

after Lt. Gen. Sir F. N. Mason-Macfarlane, subsequently Governor of Gibraltar (1942–44). At its western end, Thompson's Raise begins its long ascent to Liddell Union, which we had investigated earlier in the week.

The gallery is notable for its sequence of blast traps which, unusually, incorporate defensive loopholes; one of these bears a familiar Black Watch plaque. A series of gun emplacements provided a field of fire to the northeast. Two of these retain their guns; others are of an unusual two-tier construction and may have been adapted to some other use.

Williams Way

At Rearguard, the eastern extremity of Macfarlane's Gallery connects with the northern end of Williams Way, a 1943 lorry route resembling the Great North Road. Named after Lt. Col. A.R.O. Williams, it was built in 1943 by the 178 Tunnelling Company RE to bypass a major landslide which had blocked the road to Catalan Bay.

The Governor had telegraphed the War Office on 20 March 1943: "*Whole of scree affected in very unsafe condition. Probable that it will take considerable time to restore road communication. Completion and use of bulk petrol storage system for R.A.F. will also be affected and possibly delayed.*"

Project C

We did not follow Williams Way for any great distance but turned off up a side tunnel which led us directly into the remarkable underground facility of 'Project C'. Completed around 1945, it comprises a series of very large chambers, excavated in parallel between side access and pipeline tunnels. Each chamber contains a set of tall cylindrical petrol storage tanks. These fit so snugly into the available space that their assembly must have been quite an engineering challenge. Fuel was routed from here via the RAF Fuel Pipe Tunnel to emerge at the Orillon, below the Northern Defences.



Admiralty Wireless Station. The floor pattern indicates extensive equipment, long since removed

From here we made a short incursion into the Pearce's Chamber complex, which includes the delightfully named subterranean triumvirate of Pearce's Finger, Thumb and Toe. It dates from 1942 and, unusually, for a military work, was named after a civilian, the long-serving (1920–45) City Engineer, Mr W.H. Pearce. It comprises a warren of chambers and small gun emplacements, which must have been difficult to service with ammunition.

Macfarlane's Gallery

Backtracking, we gained Macfarlane's Gallery, which runs off in a southeasterly direction inside the line of the cliff face. This was constructed in 1940–41 and named





*Project C: two of the series of petrol storage tanks.
Photo Clive Penfold*



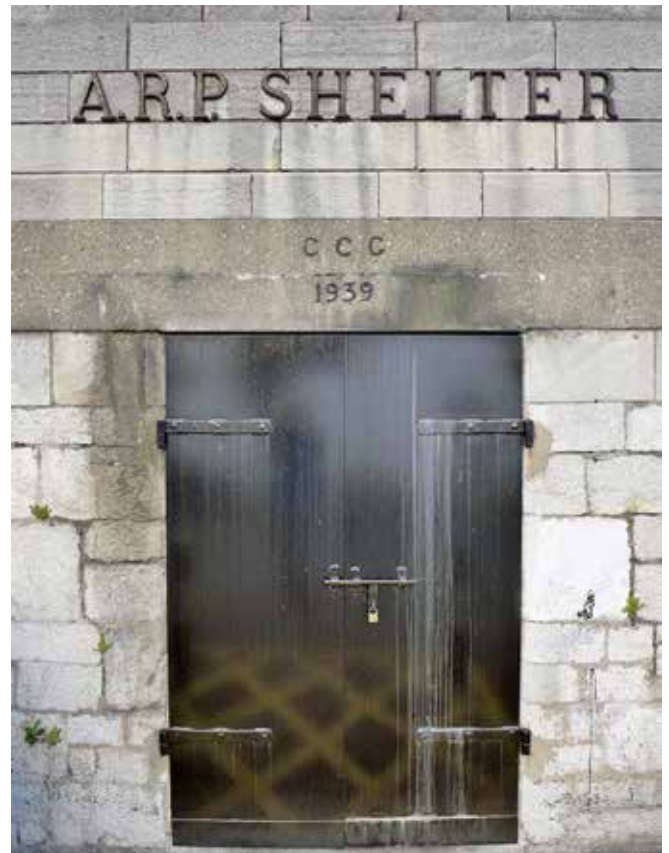
Project C: the plumbing. Photo Clive Penfold

Line Wall Air-Raid Shelter

A locked steel door set in a stone portal in the Line Wall opposite the *Bristol Hotel*, and elegantly lettered “A.R.P. Shelter G.C.C. 1939” had attracted our attention in 2016. This time I had identified the keyholder and on Friday morning Kimberley from the Ministry of Culture kindly arrived to unlock it for us.

A long dog-leg flight of steps led down into the shelter which comprises two parallel vaulted tunnels with roof vents which appeared to lead into a cavity above. At the far end, a somewhat complicated arrangement of

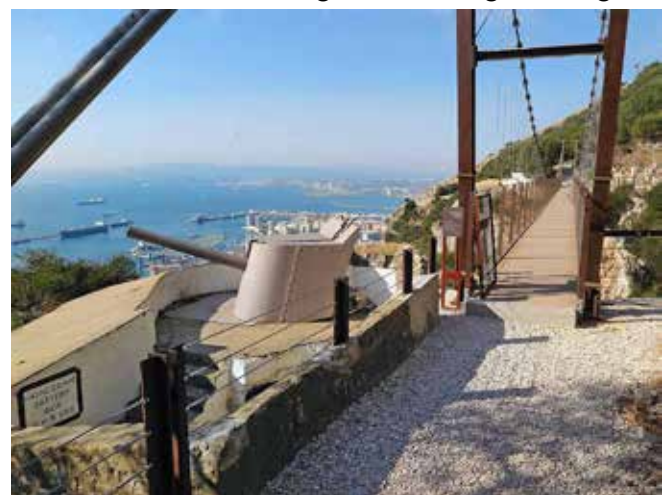
passages and spaces, leading to other entrances, made us realise that part or all of the shelter had incorporated existing casemates built within the Line Wall. Further research is needed, better to understand this interesting structure.



The entrance to the Line Wall air-raid shelter

Hayne's Cave Battery & Rooke Battery

These batteries are located on the western flank of The Rock, some 700 ft above sea level. We reached them by a stiffish climb up Devil's Gap Footpath, an 18th-century route studded with iron rings to facilitate gun haulage.



Hayne's Cave Battery: the southern gun emplacement and the new suspension bridge. Photo Clive Penfold

Hayne's Cave Battery hails from the time of the Great Siege, but its 'modern' reincarnation dates from 1904 when two 4-inch Quick Firing (QF) guns were installed in separate emplacements. These guns were designed to cover

the western approaches to the harbour. Crew shelters and a magazine were constructed in the recessed cliff face behind the emplacements. The battery was decommissioned in 1911 when its role was taken over by Tovey Battery (two 4-inch BL guns) located further to the north.

Rooke Battery, named after Admiral of the Fleet Sir George Rooke who commanded the allied naval forces at the capture of Gibraltar in 1704, was one of the later (1906) 9.2-inch BL gun emplacements built for coastal defence. A single Mk X gun was installed on a Mk V mounting. The magazine and other underground rooms are excavated into the hillside behind the gun. An unlined tunnel extends north to emerge at Hayne's Cave Battery where the crew shelters and kitchen facilities may have continued to be used after the latter battery had been decommissioned.



Rooke Battery: part of the underground works. The tunnel to Hayne's Cave Battery is beyond the arch; the magazines lie to the left, at a deeper level

The 9.2-inch gun was removed some time after 1928, at which time the battery was converted into a fire control post, equipped with a defence electric light situated on the hillside just behind and above it.

Both batteries have recently been rescued from the undergrowth in a heritage tourism project which has also seen an elegant suspension footbridge thrown across the gap between the two Hayne's emplacements.

St Michael's Cave

Upper St Michael's Cave has been known about since at least Roman times and was much visited by enterprising Victorians. In WWII it was adapted as an emergency hospital, tiers of platforms being constructed on the sloping floor of the main cavern to accommodate beds (this part has now been adapted as an auditorium), with the operating theatre located in a further large cave beyond and below this, reached by a staircase.

To facilitate access a short adit was driven to this area, in the course of which work the engineers accidentally broke through into the hitherto unknown, sterile Lower St Michael's Cave. Guided visits to the latter may be made by prior arrangement, and Steve Payne was there

to lead those of us of sufficient agility and stamina who fancied an introduction to caving.



Lower St Michael's Cave: Sub Britters attempt to walk on water. Photo Clive Penfold

The experience is described in *Subterranea* 42, only on this occasion there was (just) time for the more masochistic of us to have a go at circumnavigating the small lake in the further reaches of the cave. This is possible by edging along a *very* narrow ledge, clinging onto whatever finger-holds present themselves. Steve got us all round with his usual military wit and encouragement.

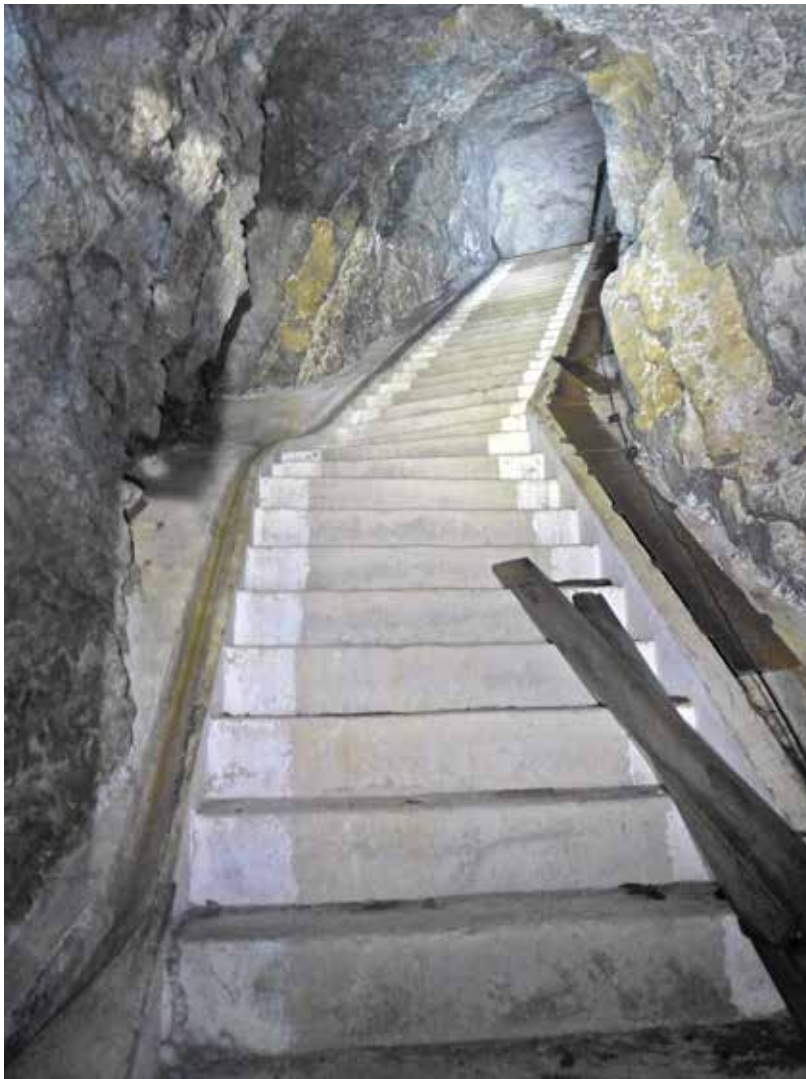
Fire Control South

Fire Control South is located in the Levant Tunnel system. This exploited a natural cave and dates from the Victorian period when Levant Cave Magazine was constructed. Located below the Levanter Cloud, which often envelops the Upper Rock, it had good visibility and commanding views across the Mediterranean. Originally a local fire control post, as the Fortress Command system developed it became 'Fire Control South': the fire control location for all the southern 9.2-inch BL guns.



Fire Control South: the iron casting is the baseplate for a rangefinder

We were shown round by Mark Ainsworth and Jean-Paul Latin, two members of the Fortress of Gibraltar Group – and also two of the team that found the Stay Behind Cave. The multi-level Levant tunnel system is quite rambling, with numerous sealed entrances and two long steep internal flights of steps.



Fire Control South: the steep stairway leading from the internal Nissen hut to the fire control complex



Fire Control South: switchgear in the eastern engine room

Some of it is now decidedly derelict. Within the complex are oil and water tanks, a ventilation plant room, two engine rooms and a rare complete original Nissen hut, neatly slotted into a long chamber. One of the two fire control posts retains the baseplate of a horizontal range finder.

The eastern engine room is located in a former magazine, impressively protected by a very substantial Victorian internal stone blast wall. On stand-down the engines and switchgear were greased and wrapped up by the military and, thanks not least to the efforts of Mark and Jean-Paul, they survive intact in this condition.

This was the final visit of the Study Tour and, as a welcome indulgence (there being no risk of setting a precedent!), a booked minibus whisked us back to town in time to sluice off the dust of the day, ready for dinner.

Acknowledgements

This Study Tour would not have been possible without the assistance of many people in Gibraltar. Steve Payne bore with good grace many months of e-mails, sanity checked the proposed itinerary and liaised with Pete Jackson to ensure it all worked 'on the night'. He and Pete were, of course, frequent companions, having first collected the necessary keys before guiding us through many of the sites. Tasmin Griffith at the Gibraltar Heritage Trust was very patient and helpful in identifying who I needed to

approach for visit permissions, and also arranged access to Devil's Gap Battery.

Numerous officials at the Department of the Environment and the Ministry of Culture readily agreed and facilitated all requested visits to sites under their care. Carl Viagas gave us another splendid tour of the Northern Defences and also introduced us to Tracy Lee who so kindly allowed us access to, and personally conducted a visit of, the Gibraltar Wine Vaults complex. Sue Davies at the Gibraltar Museum arranged access to Parson's Lodge and the Stay Behind Cave, and Phil Smith expertly guided us around both.

Luis Garcia welcomed us back to Continent 8 and showed us round ComCen. Chris Gomez and his colleague extended us a similar personal welcome to AquaGib's historic City Council reservoir site. And, in a fascinating finale to the tour, Mark Ainsworth and Jean-Paul Latin guided us around Fire Control South. We are extremely grateful to all these people and organisations for their willingly-given time and help, enabling us to see and understand something of Gibraltar's astonishing heritage.

Photos by Tim Wellburn unless stated



Sub Brit Visit to RNPF Caerwent: November 2016

CBP de Winton



The 'Jamaican Tar' trolley route to the nitrating houses in 2002. The trolleys were manually pushed full of Nitro Glycerine. The Jamaican tar was used as it was renowned to be very spark resistant. This area forms part of Nitro Glycerine Hill which has now been made a Scheduled Ancient Monument by CADW. Photo Nick Catford

Having recently joined Sub Brit mainly due to my interest in the Royal Observer Corps Monitoring Posts, I was very pleased to be able to organise a visit to RNPF (Royal Navy Propellant Factory) Caerwent. Having been a former Ministry of Defence Land Agent, Caerwent was one of the sites I used to look after; it was thus relatively easy to arrange.

It was my one and only time I met Chris Rayner, whom I enjoyed working with to organise the occasion. I would also like to thank Medwyn Parry from the Royal Commission on the Historical Monuments of Wales who also kindly assisted me in organising and running this visit.

Roman beginnings

The area in and around Caerwent has long been associated with military history, the first known area being an Iron Age hill fort towards the northeast corner of the site. The Ministry of Defence (MoD) used to own this site before transferring it to CADW (the Welsh version of Heritage England) in the mid-2000s.

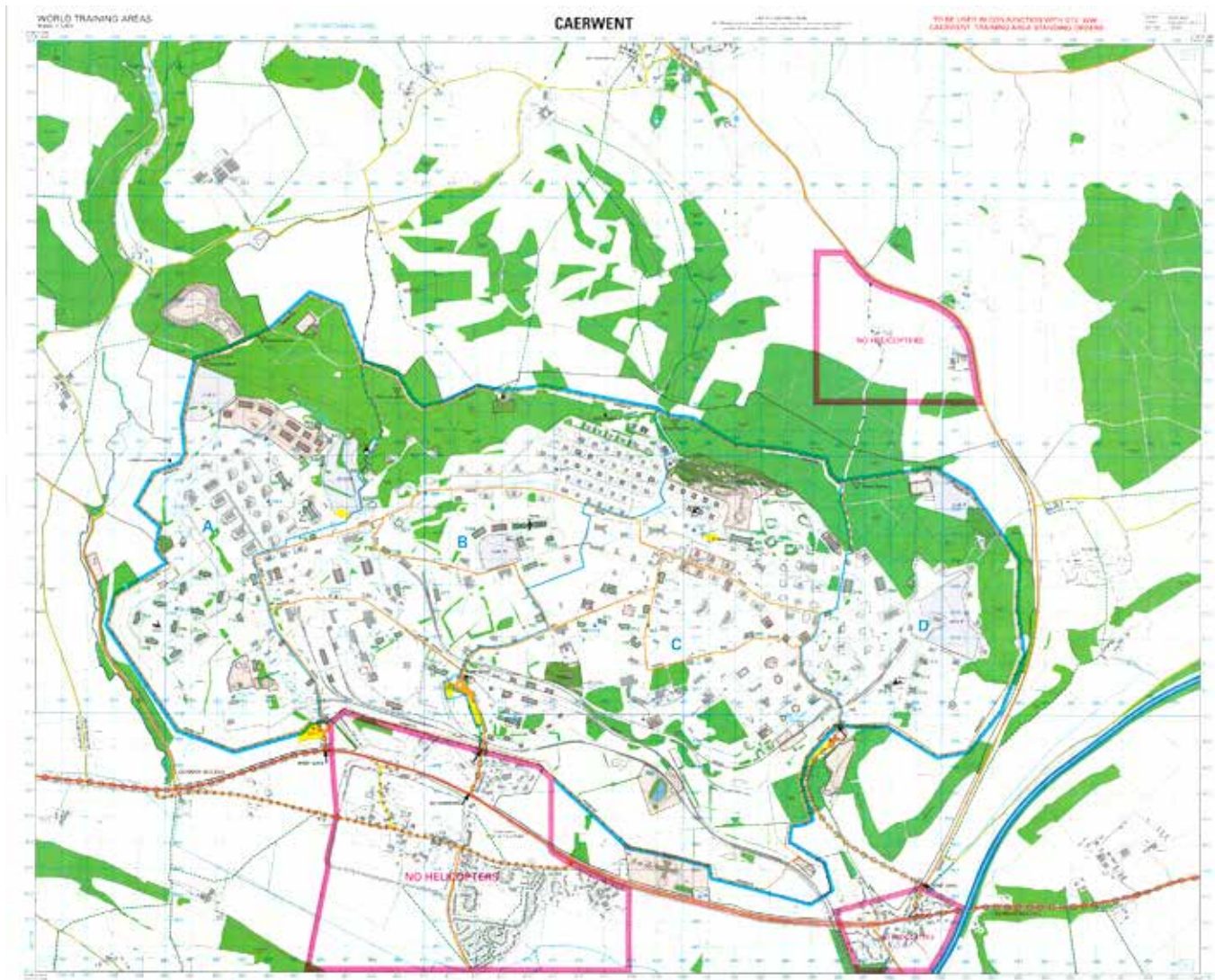
Caerwent village also has some interesting Roman remains where part of the original town wall can still be seen today. The town was founded by the Romans in AD 75 as Venta Silurum, a market town for the defeated Silures tribe. The name Caerwent translates from Welsh as “fort of Gwent”, and the name Gwent itself derives from the Roman name *Venta*.

Caerwent remained an important centre, where the road between Gloucester and Caerleon met the north-south road from Shrewsbury, via Monmouth and Trellech, to the sea at Portskewett. Important remains in and around the village have been discovered over the years. In some small wooded areas on the site, remains of clay Roman roof tiles can be clearly identified.

More recently

Prior to the twentieth century, the small hamlet of Dinham stood on the site, indeed some of the old buildings are still visible today, especially some of the old stone barns. However since the site was taken over by the War Office





in 1939, these buildings have now become ruins. Indeed the old Ordnance Survey Maps of the 1970s and 1980s still showed the original land form, and the hamlet of Dinham can be clearly seen.



The West Gate in the 1940s

With the onset of World War II the Royal Navy and the First Lord of the Admiralty at the time, Winston Churchill, had a pressing need for top-quality cordite for its warships and needed a reliable manufacturing facility. The UK was looked at in detail to find suitable sites. A number were identified but Caerwent came up as having all the qualities needed – these included a copious supply of water and good rail and road communications. Work

duly started, and so the site we visited dates back to 1939. The main reason for the Royal Navy’s need of such high-quality cordite was that lower-grade cordite with impurities can become very unstable under storage. With ships’ magazines being deep in the body of the ship, the distinct risk of cordite igniting or exploding was one that could not be taken. So the Navy had to find a way of overcoming this problem.



The West Gate today

The best solution to overcome the risk would be to set up a manufacturing facility under the control of the Royal

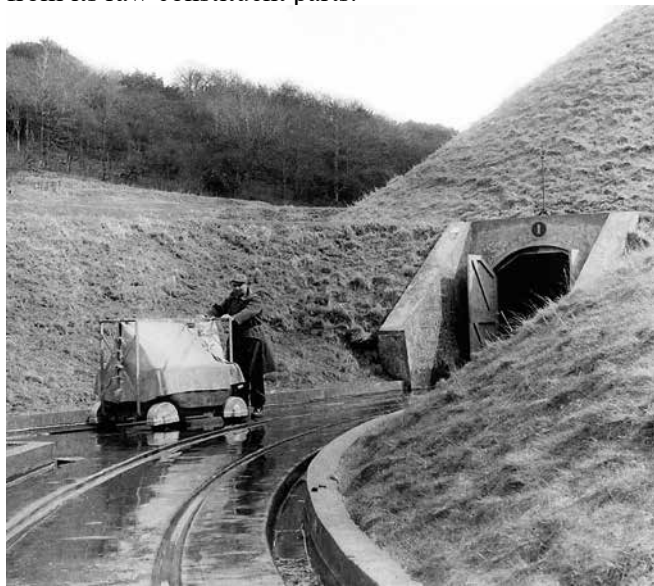
Navy to guarantee quality and purity. This was duly done and so Caerwent came into existence. Caerwent also had a sister site at Holton Heath in Dorset, although this has now been sold off by the MoD and is a nature reserve.

Construction

Construction work at Caerwent started in 1939 and the sole contractor used under the emergency war powers was Robert McAlpine; the cost of the project was seven million pounds. It was completed in a little over eighteen months. Robert McAlpine still own a small storage yard next door to the main Caerwent site.

The RNPF site consisted of two mirror factories, both operating independently of each other, so if one was taken out by accident or enemy action then the other could continue. This policy was common at the time to thwart enemy air attack and to prevent significant losses in production time. As it happened the site was never significantly bombed by the Luftwaffe – only on one occasion did a stray bomb land on the site after a bombing raid on nearby Cardiff. The site never lost any production due to enemy air raids.

The site consists of many small individual buildings either connected by a series of underground pipelines or by tarmacked roads and paths. The raw chemicals were delivered by the branch rail line and then various processes were carried out to produce the cordite. The site in effect was a chemical factory manufacturing cordite from its raw constituent parts.



A Nitro Glycerine (NG) truck. These trucks were wheeled on Jamaican tar which prevented sparks. The nitration houses as seen consisted of a wooden roof covered with earth; these were all burnt and demolished when the site was decommissioned. They were designed so the roof would blow off upwards if there were to be an explosion, not unheard of when dealing with NG!

Site layout

Each part of the process was conducted in a number of different buildings, again for two reasons: firstly to reduce the chances of widespread damage from enemy bombing. Secondly as the materials being produced, including

nitro-glycerine, were highly unstable, then if there were any accidents production stoppages could be kept to a minimum. Many of the buildings were relatively small and constructed of a simple brick design, so could be replaced or rebuilt quickly if the need ever arose.

The site consists of around 1,500 acres. The plant was carefully sited slightly away from urban areas to allow for its relatively isolated location, out of sight from enemy aircraft. The buildings were also camouflaged to make them less conspicuous; some evidence of this can still be discerned. In addition there is a good deal of woodland that surrounds the plant providing natural cover.

The site is fenced off by a ten-ft-high palisade fence with occasional right-angled defensive positions in the fence line to allow for defence of the boundary. The length of fence amounts to some five miles; during the Navy's tenure guards patrolled it by bicycle. However later on when the site was managed by the US Army, the track was tarmacked to allow motor vehicles to patrol. To this day the track is used for training military personnel and as the boundary is undulating this forms a strenuous part of the training programme.



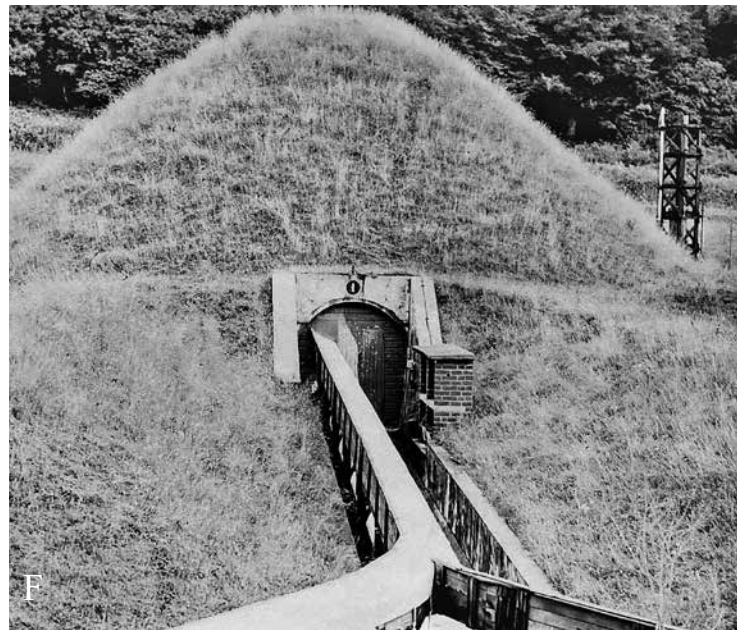
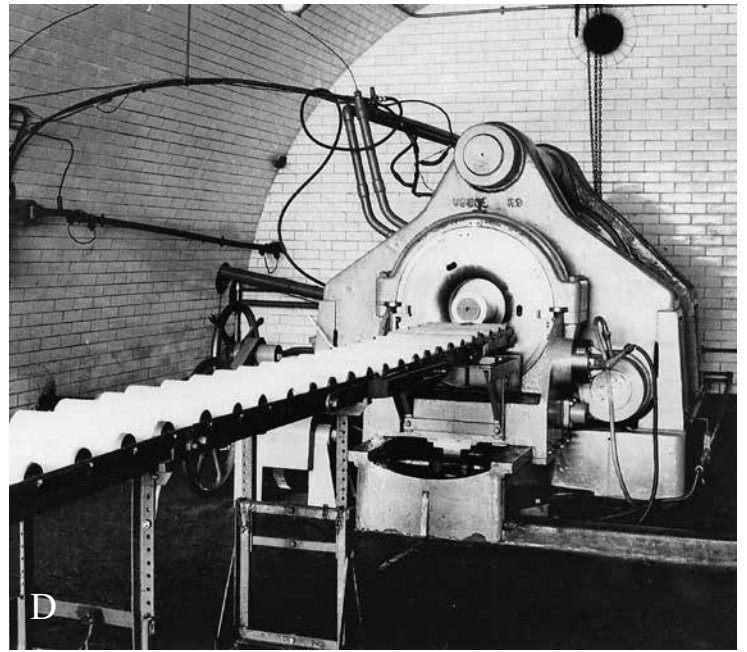
The denitration factory (Building 649) in the 1940s. Note the camouflage paint and the metalwork around it, which has now all been removed only leaving the brick building. All buildings on the site were painted in camouflage paint and some remnants of this can still be seen on some of the buildings



Building 649 today

The site is served by a railway branch line from the Cardiff to Gloucester line. The line was operational until around 2010, and in more recent years has been used for dismantling and scrapping old rolling stock.





A Dry paste mixing house and expense magazines. Designed with a timber roof with soil on top. In the event of an explosion, it was designed to keep the explosion in situ with the soil cushioning the force of the explosion, limiting the effect of the explosion on neighbouring buildings and infrastructure

B Boiler house looking northeast towards the acids factory (U1). This shows part of the extensive railway infrastructure at Caerwent; this has now been removed in many areas of the site

C The acids factory (U1) is seen in the foreground looking north-east. The area behind U1 was known as Nitro Glycerine Hill, where the components of Nitro Glycerine were mixed together; Nitro Glycerine is renowned for its unstable nature

D Horizontal press. This produced the final article of cordite to be used in the required munitions

E The transport gutters which fed Nitro Glycerine Hill with its components by gravity

F Nitration House, a similar construction of building to that of the Dry Paste Mixing House; note also the gravity pipe supply system

Water supply

In order to produce the amount of cordite required, the site required a significant amount of water. Brunel when digging the Severn Tunnel discovered the so-called Great Spring which flowed into the tunnel from the Welsh bank. To keep the tunnel dry, some nine million gallons of water per day need to be pumped out.

A pipeline was laid connecting the outfall from this source to Caerwent; this was a major factor in determining the location of the site. In addition to the Caerwent site using part of this abundant water supply, a brewery and a paper mill both took advantage; all have now closed in recent years and this abundant supply of fresh water is now merely pumped out into the Severn Estuary. The conduit leading from Sudbrook to Caerwent is a 28-inch pipe which mostly follows the path of the branch line. The site at Caerwent is prefixed by the letters RNPF – this stands for Royal Naval Propellant Factory. Production came on stream in 1940; however it was not until 1941 that the site was at full production and remained so until the end of World War II. The workforce operated a three-shift system, allowing 24 hour a day working.



The exit end of the rolling house (Building 809) in the 1940s



Building 809 today

Some six thousand people were employed, many travelling from the South Wales valleys and Gloucestershire via the branch line and station. The site had a number of additional facilities which are probably not common with more modern industrial developments. For example, there was a fully equipped hospital with its own operating theatre, a theatre for social entertainment and a number of shops.



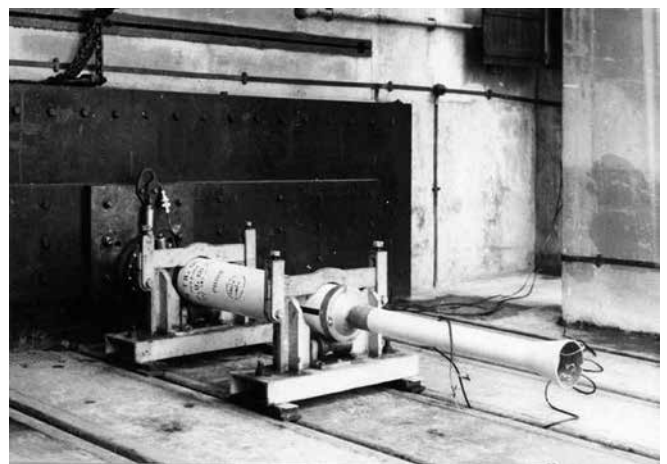
Inside Building 809

The site continued producing cordite until the late 1940s when it was slowly run down and decommissioned. Areas of wooden infrastructure such as the nitro-glycerine pouring sheds which consisted of wooden roofed sheds were burnt and demolished. However many of the other features of the original site have remained. Sadly for Sub Brit members, there are no underground bunkers or similar infrastructure on site, just a handful of WWII air-raid shelters.

Cold War reuse

During the 1950s the site played a crucial part in the Cold War. After World War II, the military realised it needed re-equipping with modern missiles and defensive systems. The three services developed their own missile systems, the *Bloodhound* for the RAF, the *Thunderbird* for the Army and the *Sea Slug* for the Royal Navy. All three missile systems relied on the Gosling Rocket Motor as their means of primary propulsion.

Each of the three variants employed four Gosling Rocket Motors for the initial launch phase of flight. These rocket motors were tested at Caerwent in purpose-built bunkers. Naturally these buildings at Caerwent were Top Secret in their day, and when I was managing the site we oversaw CADW designating these structures as Scheduled Ancient Monuments, along with 'Nitro Glycerine Hill' which was used in connection with the cordite-making process.



Gosling rocket in firing bay being assembled





Rocket firing bay



Above and below - the firing bay and associated building, now a Scheduled Ancient Monument



The *Sea Slug* naval variant is probably the most interesting of the trio of missiles. It was designed solely by the British, being a sea-to-air missile capable of being launched from on board a ship at sea. During development, a purpose-built rolling deck was developed at Aberporth, near Aberystwyth on the Welsh coast – this was to mimic the nature of a rolling ship at sea.

This innovative device meant that the British beat the Americans in the development of a sea-to-air missile system that remained in service until the Falklands War, though it was deemed soon after to be obsolete. *Sea Slug* was fired in anger a couple of times, but was retired very shortly afterwards.

French leave

In the mid-1960s, the French government under General de Gaulle expelled the American military and NATO from French territory. The US Army now had a problem: where should it store its European strategic arsenal?

Caerwent was subsequently chosen for this task as the site had a good rail link and was a secure location in a quiet part of Wales. The site then became RAF Caerwent and was handed to the US Army. Work began in constructing a number of steel and asbestos industrial buildings to house the US armaments, although sadly this involved demolishing a number of the wartime RNPf buildings. A significant number of concreted roads supported these new buildings and new street names such as Pennsylvania Drive appeared. It is said that the site housed a number of cruise missiles. The site's vegetation was heavily managed in order to prevent fire risk. The US Army remained here for 25 years right up until the First Gulf War in 1991, after which the site was evacuated and handed back to the MoD.

Conservation value

After the First Gulf War, the site lay dormant for a number of years, as the MoD had little use for it. During this time much of the vegetation grew back and buildings were on a care and maintenance budget.

At large sites such as Caerwent, when nature is allowed back all sorts of interesting habitats started to blossom, especially as the area was still secure and the public kept out. Colonies of lesser horseshoe bats and barn owls became established and the factory became host to five Sites of Special Scientific Interest (SSSI). Great crested newts also thrive here, much to the delight of conservation groups but equally presenting a headache to the MoD!

Training

Ironically with the onset of the Second Gulf War, the Army soon realised the significant training value that the site had to offer. As all the main infrastructure was switched off in 1991, any training unit had to use more realistic field training techniques. The large number of low-rise buildings replicated the type of buildings commonly seen in Middle Eastern countries, especially Iraq and Afghanistan. The site has in recent years been heavily used for pre-deployment training prior to active operations in these theatres.



A Forward Operating Base (FOB); troops can be seen in the middle of the picture

Caerwent has many buildings situated within the secure site boundary. A number have been damaged by training troops practising their explosives techniques, although

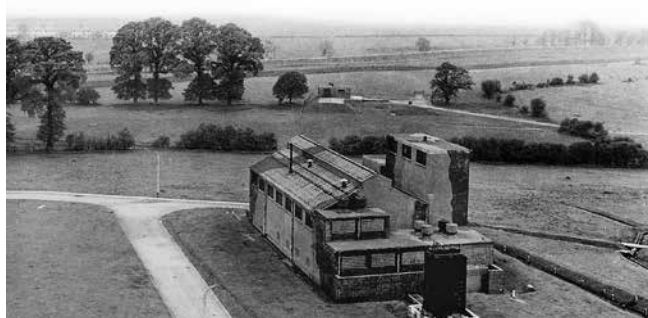
this practice has now been largely outlawed due to health and safety issues. The site is still heavily used for military training and a number of the buildings are used for this. Where buildings are of use for non-military storage, they are let to third parties as low-quality secure storage; these uses are however limited due to the materials being stored and because very few buildings have the benefit of services such as water and electricity.

Sub Brit visit

The small Sub Brit group that visited the site in November 2016 was able to see evidence of all four phases of the site's history – the Royal Navy Propellant Factory, the test rigs for Cold War missiles, the US Army storage units and modern-day troop training. The first included some of the air-raid shelters and the extensive railway network that once spanned the site. The last included a replica forward operating base complete with sangar. At one stage we came across a detachment of soldiers under training (luckily not live fire) and we beat a hasty retreat. The site was clearly important to the Royal Navy and the skills of the workforce were of equal importance to the Navy. The site afforded some key additional facilities to its workforce which mirrored more of a military establishment rather than a chemical factory. The site provided a fully functioning hospital and associated theatre. A full welfare hall which provided social facilities such as a cafe, bar and a fully equipped theatre.



Welfare Centre - Grocery Store



SA Factory. Note the camouflage paint and the general layout of the site. Sites such as this were very spread out to allow production to continue in the event of an air raid or on site explosion



Theatre in the welfare centre



Hospital operating theatre

Today Caerwent is very popular as a filming location and regularly features on programmes such as *Doctor Who*, *Torchwood*, *Top Gear* and *Captain America*.

Missing on maps

Prior to 1940, the site incorporated the old hamlet of Dinham of which some of the old buildings still remain today. However if you happen to have an old OS map from 1960 through to the 1980s the old village is clearly marked, and there is nothing about Caerwent and its immense infrastructure!

Caerwent is probably one of the few military sites which has been in the employ of all three armed services. We are fortunate that the majority of the site still stands as it did in 1940, with however interesting signs of its more recent uses. Sites like this and its size are relatively rare as there are ever-increasing demands on its land resource. Small parts of the original site have been sold off for housing and it would be a great pity if the site were to go in the future.



A more modern building constructed by the US Army
I intend to run a regular annual trip to the site and can take up to about 15 to 20 people on each occasion.



Nottingham Day Conference & Visits

20–22 October 2018

Our Autumn Conference this year is in Nottingham, a city well-known for its caves and underground spaces.

Day 1 (Saturday) is the conference, which will be held at the British Geological Survey (BGS) at Keyworth, just outside the city, but easily accessible by public transport.

This is the first time we have been to the BGS, and it should be fascinating to discover the work that they undertake. Presentations will be based on local East Midlands underground topics, including Dr Andrew Hughes of the BGS, Dr Tony Waltham on Nottingham's caves, David Dawson (Inland Waterways Association) on Butterley Canal Tunnel, Scott Lomax (City Archaeologist) on recent underground discoveries, and Christopher Gray on Victoria Railway Station and its tunnels.

Following the conference there will be an optional evening meal in an underground location in central Nottingham.

Day 2 (Sunday) is composed of site visits, including Papplewick pumping station (with underground reservoir), Cresswell Crag prehistoric cave system, and Welbeck Abbey carriage tunnels.

Day 3 (Monday) will offer site visits within the city including Rouse's Sand Mine (with WWII shelter), Rushcliffe Borough Council Nuclear Bunker, Cemetery Mine & Catacombs, and Broadmarsh Caves (including a usually off-limits and recently excavated section).

It is intended to do booking for each day separately as numbers are restricted particularly for Sunday and Monday; however members should note that bookings will not be accepted for either or both of Sunday and Monday in isolation (ie visits are only open to those attending the Saturday conference).

Accommodation

You should note that no accommodation has been booked for this event, and members are requested to book their own once their place has been confirmed. There are several Travelodge and Premier Inn sites in the City, and a variety of other budget and not-so-budget accommodation available. We will make suggestions of convenient hotels prior to the start of booking.

Booking

Booking will open on Friday 1 June, when full details will be given. The cost is likely to be around £75 for the full three days. We'll send an email to all members prior to booking opening.



Rouse's sand mine. Photo Nick Catford

Crystal Palace service tunnel?

Nick Catford



Crystal Palace and the Crystal Palace High Level station looking north in 1929. Sir Joseph Paxton's tunnel runs between the two water towers. The Paxton railway tunnel is seen at the north end of the High Level station. Photo courtesy of Britain from Above

Information about a previously unknown service tunnel at Crystal Palace in south London has recently come to light. The tunnel is listed as a 'saleable asset' of the Crystal Palace Company in the first edition of the 1911 Crystal

Palace Sale Catalogue published by auctioneers and estate agents Knight, Frank & Rutley.

The Palace was due to be sold by auction on 28 November 1911 but the sale was subsequently cancelled. The exact wording in the catalogue says: 'This tunnel is connected with the railway, and is used as a roadway for bringing into or taking from the Palace heavy materials and objects – an arrangement that leaves the main floor of the building independent of such operations.'

The last sentence implies that the tunnel must have entered the Palace at basement level. It should be noted that the text says 'connected with the railway' and not 'connected to the railway'. There is no suggestion that the tunnel was laid with rails.

A palace in Hyde Park

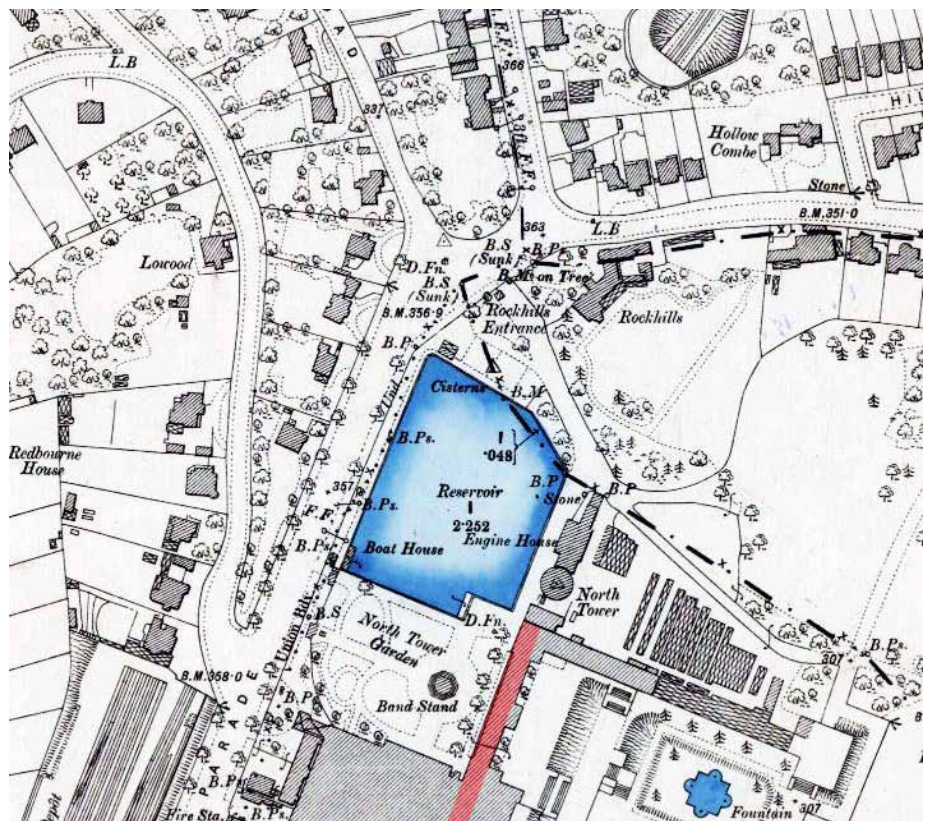
The Crystal Palace in Hyde Park was designed by renowned gardener and architect Joseph Paxton (1803 - 65). Paxton was knighted in October 1851 in recognition of his work. When

the Palace was relocated to Sydenham Hill in south London, Paxton was again involved.

There were a number of differences between Paxton's original Palace and the rebuilt Palace. One of these was the addition of a basement which contained the plant for warming the building with rows of furnaces and boilers, and a network of fifty miles of iron steam-pipes. There were thirty boilers, arranged in pairs along the basement level at regular intervals. For ease of movement of coal and coke, the basement would almost certainly have had a hand-pushed narrow-gauge railway.

The basement was not a conventional basement. Patrick Beaver's book *The Crystal Palace* includes a plan of the Palace and the basement comprises a long narrow room taking up the slope of the hill along the whole width of the south front of the Palace. The basement was always referred to as Sir Joseph Paxton's Tunnel although it was not in reality a tunnel.

The statement 'This tunnel is connected with the railway' implies a possible link to the Crystal Palace and South London Junction Railway. The railway was authorised in 1862 to build a line from Peckham Rye to a large covered



1895 1:1056 OS Town Plan which shows the north end of the Palace. Sir Joseph Paxton's basement Tunnel is coloured pink. The Paxton railway tunnel south portal is seen bottom left with the north portal top right. Rockhills is Sir Joseph Paxton's house. The house was destroyed during WWII. Two Grade II listed gate piers survive with a blue plaque to commemorate Paxton



terminus alongside the Palace. The terminus was known as Crystal Palace High Level station.

The station was built on an excavated ridge below Crystal Palace Parade requiring major engineering works and a high retaining wall. A high-level subway under Crystal Palace Parade was provided for first-class passengers allowing them to easily reach the Palace grounds. At the east end of the station the line entered the 439-yard Paxton tunnel. The station had no goods facilities but there was a small coal depot between the Paxton tunnel and the station on the west side alongside Farquhar Road.

Tunnel confusion

An unpublished manuscript titled *Crystal Palace Accident or Arson?* by Robert H. Knowles about the Crystal Palace fire on 30 November 1936 mentions the service tunnel but is confusing. The Crystal Palace Foundation was given the manuscript and research material by the author, now deceased, some years ago. It describes two tunnels, the subway and a service tunnel from the basement to the Paxton railway tunnel. It says:

There were two offshoots from the basement area. One was at right angles to the basement proceeding in a westerly direction under Crystal Palace Parade to the High Level railway station, from where visitors had direct covered access from station platform to the south and centre transepts. It is a fine example of nineteenth-century arched brickwork and remains in a good state of preservation to this day. The second offshoot ran north bypassing the base work of the north tower to link up with the High Level Station railway tunnel. Through this tunnel there was a direct rail link to the Palace basement, making convenient movement for heavy bulk objects, and for the considerable quantities of coke consumed by the central heating boilers.

The manuscript goes on to suggest that an arsonist used the service tunnel to access the basement area of the Crystal Palace to start one of two fires in the building.

Despite what the manuscript claims, there could be confusion between the Paxton railway tunnel and Sir Joseph Paxton's tunnel. It is highly unlikely that the service tunnel actually connected with either the railway or the railway tunnel as the basement of the Palace is at a much higher level than the railway and, as the Palace and the railway are close together, any connecting tunnel would have to be so steeply inclined that it would be unusable as a roadway. It would also be totally impractical to unload goods from wagons inside the busy Paxton tunnel and transfer them to a side tunnel. A more likely starting point for the tunnel would be from the coal depot but this would have required a tunnel running under the lines into the station.

Significant omission

The wording in the second edition of the sale catalogue is the same but the sentence 'This tunnel is connected with the railway' has been omitted.

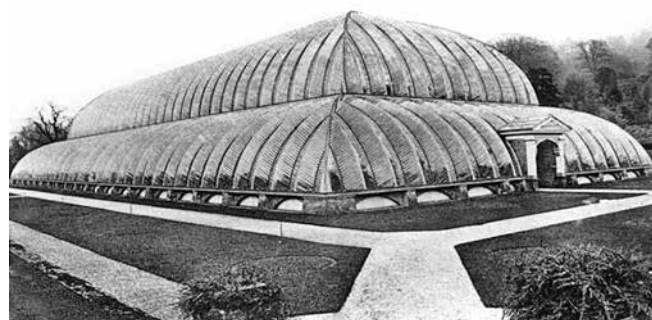
It is possible that a service tunnel of some sort did exist somewhere but apart from reference to it in the sale catalogue and Knowles' manuscript there is no other evidence of it or where it might have run. The author has walked through the Paxton railway tunnel on a number of occasions and saw no evidence of a bricked-up side tunnel but it could have been missed as he wasn't looking for it. It is not shown on Patrick Beaver's Palace plan or on any large-scale Ordnance Survey maps.

If, as the sale catalogue states, it was a roadway tunnel, it is likely to have been at the north end of the Palace and the manuscript describes it as 'bypassing the base work of the north tower'. It is clear that the Palace would have required coal for the boilers which could have been delivered by road to the engine house via the Rockhills entrance but there would be little point driving a tunnel here as there is road access up to the north tower.

Neither map has any evidence of the service tunnel or where it might have run. The reservoir which fed the two water towers would have blocked its route to the Paxton railway tunnel. Any information from our readers about this mysterious tunnel would be gratefully received by the author.

Chatsworth's Great Conservatory

Paxton did have form for building service tunnels. Fifteen years before the Palace was built in Hyde Park, Joseph Paxton designed the Great Conservatory for Chatsworth House in Derbyshire. To create the tropical climate required for the exotic collection of plants and trees, the conservatory had a basement with eight underground coal-fired boilers which fed a seven-mile network of 6-inch hot water pipes.



Chatsworth Great Conservatory

The coal was delivered to the boiler in narrow-gauge railway wagons from a recessed brick-lined bunker known as the coal hole a short distance from the conservatory. From the coal hole, a short stone-lined tunnel ran into the basement of the conservatory. In winter, it took 300 tons of coal to fuel the boilers. The boiler fumes escaped through flues laid along the ground to a chimney in Stand Wood, well out of sight of the garden.

Paxton's Chatsworth conservatory was 275ft long, 121ft wide and 62ft high, and was the largest glass building



Chatsworth coal tunnel

in England until the erection of his Crystal Palace in London. During and after WWI, there was insufficient

coal available to heat the conservatory with the result that many plants died and the building soon fell into semi-dereliction. Because of the high cost of restoring and maintaining the conservatory, it was demolished in 1920 leaving just the supporting walls; these now enclose the popular yew maze.

Although the tunnel mouth in the coal hole was always open there was a blockage further along the tunnel. In 2002, filming at Chatsworth encouraged an exploratory dig to assess the blockage. Clearing of the tunnel and coal hole revealed that it had been infilled with rubbish including plants and pots from the Great Conservatory during its demolition. The tunnel was excavated, the railway tracks were removed, handrails and lighting were installed and the coal hole and tunnel were opened to the public in 2003.

SOURCES:

The Crystal Palace Foundation

1911 Crystal Palace Sale Catalogue published by auctioneers Knight Frank & Rutley

The Crystal Palace by Patrick Beaver

Crystal Palace Accident or Arson? – unpublished manuscript by Robert H. Knowles

Roger Morgan

Sub Brit website

Chatsworth House website

British History Online Chapter XXIII.

William Smith's unsuccessful underground Bath stone quarry, Somerset

William Smith [1769 – 1839] has been called the 'father of English geology' and compiled the world's first geological map of an entire country (England and Wales) published two hundred years ago. He was, professionally, a civil engineer and mineral surveyor, engaged in canal building, coal mining, and other enterprises. Members of the Geologists' Association visited a number of locations associated with Smith in and around Bath and the Somerset Coal Canal, south of the city, on 6 June 2015. The excursion was led by Hugh Torrens, who has devoted much time to researching the history of geology in general, and of William Smith and his maps in particular.

The published report on the meeting includes some details of Smith's failed stone quarrying enterprise near Tucking Mill, south of Combe Down. As with many other underground Bath stone quarries in this area and further east at Box and Corsham, the quarry was worked by tunnelling into a hillside. The enterprise failed, whereas of course many such quarries prospered and became (as at Box, Corsham and Monkton Farleigh) very extensive, and were very useful for World War II munitions storage and a Cold War government control centre. The failure of Smith's underground quarry was the result of the limestone bed outcropping on the hillside having started breaking away from the main mass and starting to slip down the hillside. His tunnelling,

therefore, was through rock with frequent dislocations and open joints. This made quarrying less productive, and more hazardous. And discolouration from soil from the surface washing down the fissures and staining the stone, reducing its value for fine building in Bath.



The report notes that there is now a new community museum at Combe Down, the 'Ralph Allen CornerStone' (<http://www.combedownheritage.org.uk>) operated by the Combe Down Heritage Society. Here, 'the history of [underground] quarrying of Bath stone is well documented with tools, maps, prints and photographs'. The recent infilling of much of the quarry tunnels under Combe Down is also fully treated in the displays. The Heritage Society has, too, published (in 2009) a book by Richard Irving on 'William Smith and his venture into stone manufacture'. SOURCE: HENRY, John, 2015, Field meeting report: William Smith & Bath. *Magazine of the Geologists' Association* 14 (3), 15 – 18.

A day underground in the Gemeentegrot at Valkenburg, The Netherlands

Paul Sowan

Your scribe has been visiting the impressive subterranean building-stone quarries in the Maastricht area and contiguous parts of Belgium for over 40 years, and made many friends there over the years. It was therefore an offer to be accepted with alacrity when I was invited by Joep Orbons to attend the 40th anniversary celebration of the Studiegroep Onderaardse Kalksteengroeven (Study-group for Underground Limestone Quarries). This very sociable event took place on Saturday evening, 7 October, in a remarkably cosy bar in a quarry below the streets of the small Belgian village Zichen, which falls within the Riemst local authority area. SOK evidently enjoys excellent relations with the municipality of Riemst and, indeed, the Mayor joined us underground and started the evening with a welcoming speech. This was an opportunity to renew acquaintance with several friends of long standing. We chatted about British and Dutch stone quarries, bat conservation, and so forth.



*SOK 40th anniversary celebration underground.
Photo Joep Orbons*

As if further inducement to travel to Maastricht again were needed, Joep suggested a couple of days in the quarries area. Most of the Saturday was, therefore, spent underground at Valkenburg. On Sunday, we enjoyed life on the surface, just as important in understanding underground sites as prowling about in the dark.

The Gemeentegrot (Municipal Quarry) is owned by the Municipality of Valkenburg, an historic small town with well-preserved castle ruins on the small river Geul, a tributary of the Maas (called the Meuse when it flows through the French-speaking part of Belgium). Several underground quarries in the town are operated as tourist attractions, including one impressively adapted and filled with coal-mining equipment as a museum of the former Dutch coal-mines near Heerlen near the German border. Members of Subterranea Britannica when we visited will remember the sites.

The main quarry is an extensive network of roomy tunnels which has been a visitor attraction for many years, an air-

raid shelter during the last World War, and contains also a well-engineered Cold War bunker. It is also amongst the most important bat hibernation sites in the Netherlands. Bats being protected species in the Netherlands, as in the UK, there is official anxiety that intensive tourism may harm them. Bats aroused from hibernation tend to fly around in search of food, mainly flying insects, using up their food reserves stored up to see them through the winter. On failing to find food, they are then liable to die of starvation before the next spring.

There are numerous guided tourist trips daily in a selected area in the quarry, some on foot and some by 'land trains', with a 'sound and music' attraction at one point. And in November and December there is a very popular Christmas market (Kerstmarkt). There are also more remote areas underground where abnormally warmer temperatures are found.

Rather than a blanket ban on tourism during the winter and the Christmas Market (thereby losing a popular visitor attraction and source of income) the town council has elected to commission a detailed study of temperature fluctuations and air circulation patterns within the very extensive labyrinth of tunnels.

Joep and others have been commissioned to carry out an extended programme of environmental monitoring.



*Placing temperature sensors in Gemeentegrot.
Photo Joep Orbons*

The day was spent with Joep and two colleagues drilling narrow holes about 1.5 metres deep into the quarry walls and selected locations, into which temperature dating-logging sensors were inserted. These will continuously record temperature and fluctuations deep into the solid rock. Two possible sources of extraneous heat in the rock, of the order of 1.5° C above normal have been suggested: a former cannabis farm and a 'health and beauty spa' on the surface. My own role was to assist as porter ferrying

equipment from location to location. Although I have visited this quarry several times (with SOK members rather than as a tourist) it was a great opportunity to see again some of the more spectacular areas, and some areas new to me. These included the Cold War bunker area, the equipment in which appears to be in very good condition. As the ventilation system necessarily is within this area, and as the air flow through the quarry is a part of the commissioned study, Joep has of course the keys to everything! Your scribe, uncharacteristically, could hardly resist a few photographs of underground concrete and gaily painted plant! Mostly, however, the bare rock, rock fissures, tool-marking patterns, and graffiti were the

main points of interest. In the Maastricht area, blocks of stone have been sawn out for some centuries, leaving smooth sawn surfaces used over time both for inscriptions (names and dates and the like) and large drawings, many of artistic merit and great historic value. Stone saws were used in England in the Box quarries for Bath stone from the 19th century onwards, but not at all in, for example, the Reigate stone quarries in east Surrey. With a lack of smooth surfaces, the quarry walls at Merstham, especially, have very few historic writings.

There is still stone extraction carried on underground at Sibbe, near Valkenburg, to this day.

Early Thames Subways

The North and South Woolwich Subway and other failed schemes for a Thames crossing at Woolwich

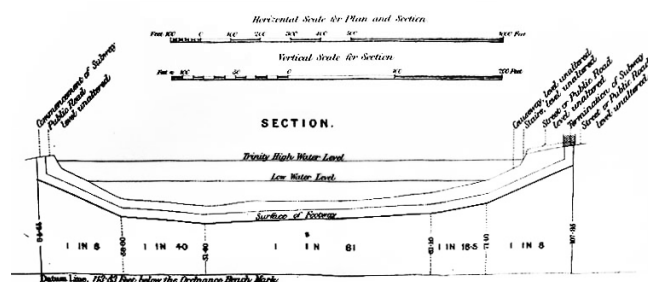
Peter Bone

The Woolwich foot tunnel was built by the London County Council and opened in 1912 (see *Subterranea* 37), but more than a quarter of a century earlier, an attempt was made to create a foot tunnel under the Thames at Woolwich. If it had been completed, it would have been only the third tunnel constructed under the Thames, following Brunel's Thames Tunnel at Rotherhithe (1843) and Peter Barlow's Tower Subway (1869).

Growing need for a Thames crossing at Woolwich

The Eastern Counties Railway opened a railway from Stratford to North Woolwich in 1846. In 1847 the company began running a steam ferry service from near their North Woolwich station to Woolwich. However, the service did not run in foggy weather. In the mid-nineteenth century there was a growing need for a reliable way for people to cross the Thames here; employment in manufacturing industries grew on both sides of the river, employment in the Woolwich Arsenal expanded, and new housing was built at North Woolwich. There are newspaper reports of people drowning when attempting the crossing in boats when the ferry was unable to run.

In 1873 the North and South Woolwich Subway Company was formed. Plans for a pedestrian tunnel between Woolwich and North Woolwich were prepared and deposited with the Clerk of the Peace for Kent. Copies of these are held by Kent County Archives and the London Metropolitan Archives. They show the tunnel starting just to the east of the old North Woolwich Station and terminating near the junction of Bell Water Gate and the High Street in Woolwich (just east of where the Leisure Centre is now).



Cross section. Courtesy Kent County Archive

The proposed alignment was therefore about 25 metres east of the tunnel completed by the LCC in 1912. The profile of the proposed tunnel was also similar to the 1912 tunnel, with the footway sloping down from both ends towards a flat section about a third of the way through the tunnel. It was designed for pedestrians only; contemporary newspapers describe it as being 12 feet high and 9 feet wide. The original plan was to dig the tunnel through the water-saturated sand and gravel which forms the bed of the Thames. The company proposed to levy a penny toll for each crossing.

Plans for a Pedestrian Tunnel: 1873

In 1874 parliament approved the North and South Woolwich Subway Bill which permitted construction of the tunnel. Parliamentary papers report that the North and South Woolwich Subway Company Ltd had been incorporated and proposed to fund construction through issue of company shares for £60,000 and raising loans for £20,000. The plans name F. Gilbert and J. Greathead as the Engineers for the project.

James Greathead had been a pupil of Peter Barlow, the engineer for the Tower Subway. Barlow was the



chief engineer for the Tower Subway and Greathead the civil engineering contractor. Barlow had developed and patented Brunel's 'tunnelling shield' apparatus for tunnelling through saturated strata. James Greathead further developed the shield-tunnelling methodology while working on the Tower Subway, and was granted a patent for these improvements. Many of Greathead's innovations remain standard features of modern tunnelling through soft saturated strata, for example in the recently completed Crossrail tunnels.

The tunnelling shield that Greathead and Gilbert commissioned for the Woolwich Subway, provided space for four men to work simultaneously at the tunnel face. The shield supported the newly excavated tunnel walls. Air locks and use of compressed air prevented water seeping through newly dug walls. Hydraulic powered screw-jacks were to be used to move the shield forward. Immediately behind the advancing tunnelling shield, hydraulic-powered lifting apparatus was to be used to line the tunnel with cast-iron segments.

Messrs Collins and Thompson of Middlesbrough were commissioned to build the shield. James Greathead records that the shield, air locks, lifting apparatus and large quantities of cast-iron tunnel lining segments were constructed.

Construction and Failure 1876–1884

The contract for construction was let to Messrs Sharpe of Cannon Street in 1876, and construction started in August 1876. However it appears that both the contractor and the North and South Woolwich Subway Company faced financial difficulties. Newspapers report the company was involved in a dispute in the High Court with the National Deposit Bank in 1877, and with Mr Pym, a former Director of the company, in 1878 about his financial liabilities for the company's debts.

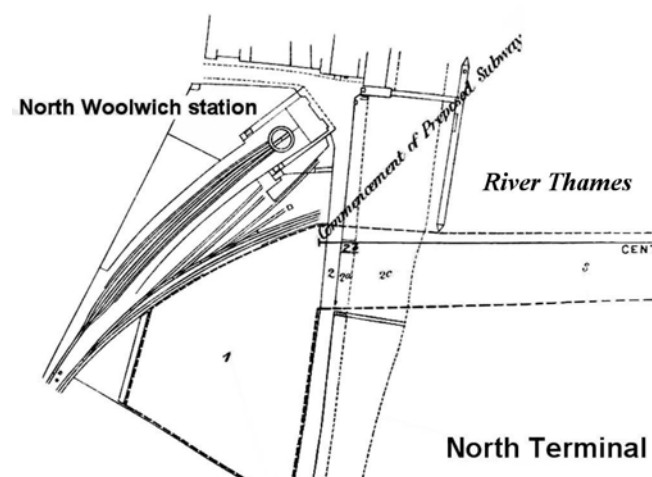
In 1887 there was a new Bill in Parliament to extend the time limits for construction granted in the 1874 Act. This was passed unopposed in 1879, and in 1881, a third Act was approved to extend permission for construction until 1884.

James Greathead wrote that Sharpe, the contractor, abandoned the contract 'due to difficulties elsewhere', but does not give a date for this nor say what these difficulties were. Another contractor, Mr T. A. Walker offered to undertake the work. Greathead says that Walker "did not believe in the shield method and expressed his willingness to work in his own way, driving the tunnel deeper through the chalk strata". Greathead says that the company accepted Walker's offer to construct the tunnel because of "absence of financial strength".

Walker started work in 1879. An entrance shaft at North Woolwich was dug, but Walker found it impossible to

proceed far with the tunnel even though compressed air, without a shield, was tried; the undertaking was subsequently abandoned.

In June 1883 there was a fire in the wooden staging over the entrance shaft at North Woolwich. *Lloyds Weekly Newspaper* reported that Henry Wilson aged 22 was killed during the fire, falling down the shaft. I think it is likely that this is when construction was abandoned. The North and South Woolwich Subway Company was wound up in June 1884 and parliamentary approval for the tunnel also expired that year.



Courtesy Kent County Archive

Why did the project fail?

We cannot be certain of the reasons for the abandonment of the project, but a number of possibilities are worth considering.

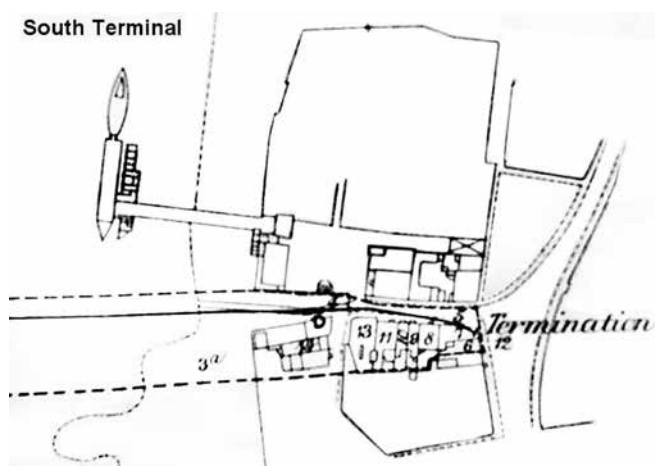
1) Was the original civil engineering design inadequate? Prior to designing the Woolwich Subway project James Greathead had successfully completed the Tower Subway using the same methods. Greathead went on to have a very successful career as a civil engineer, particularly in tunnelling for railways including the Waterloo and City line and the City and South London Railway (now part of the Northern line). His credentials for this project are excellent. The foot tunnel built by the LCC in 1912 used methods very similar to Gilbert and Greathead's plan. So, I think it is unlikely that the original plans were the reasons for the failure of the project.

2) Was Mr T.A. Walker to blame? Reading Greathead's account, it's tempting to imagine Mr Walker as some kind of nineteenth-century cowboy builder who offered to construct the tunnel cheaply but failed. However Thomas A Walker (1828–89) was a very successful civil engineering contractor; his later works included construction of the Manchester Ship Canal. In 1879 (around the time of his involvement with the Woolwich Subway), he was appointed to undertake most of the construction of the Severn Rail Tunnel. Work

on the Severn Tunnel by an earlier contractor had resulted in catastrophic flooding. Walker successfully completed the four-mile Severn Tunnel. This was a much bigger and more complex project than the ¾ mile Woolwich subway. However the Severn Tunnel was through hard-rock strata, and used a tunnelling method which did not require Greathead's shield methodology. Walker was a very accomplished civil engineer, but it's worth considering the following:

3) Did work on the Severn Tunnel distract Walker from the smaller project at Woolwich? He did not understand the difficulties of tunnelling through saturated soft strata, and wrongly rejected Greathead and Gilbert's methods. He underestimated the cost of the construction and subsequently abandoned the contract.

4) Did the project fail for financial reasons? The High Court cases in 1876 and 1877 suggest that the company had money problems, "because of absence of financial strength". James Greathead was not only a civil engineer, but also a civil engineering contractor who had successfully completed the Tower Subway construction. I think that it is significant that he did not take on the construction contract when Sharpe abandoned work. Perhaps Greathead could see the financial weakness of the company. There may be more information about the finances of the company in the reports of the High Court cases.



Courtesy Kent County Archive

Parliamentary papers report that the company had raised £80,000 through shares and loans. The Woolwich foot tunnel built by the LCC is reported to have cost £78,860 to construct. So it appears that the company initially may have had adequate capital for the project. However we do not know how much money was wasted when Sharpe abandoned construction and Walker restarted using a different method of construction.

5) Was the project undermined by the public sector? In 1880 the Woolwich Board of Health promoted the idea that there should be a publicly-run free ferry crossing at Woolwich. By 1883 this idea had been taken up by the Metropolitan Board of Works, and

in 1884 parliament passed legislation for this. New piers were constructed by the MBA which opened the free ferry service in 1889 replacing the toll ferry crossing. The free ferry did not overcome the problems of unreliability during foggy weather, but would have undermined fee income from a toll foot tunnel and made further investment in the subway project unattractive.

Two other uncompleted tunnel projects at Woolwich

In his book *London's Lost Tube Schemes*, Anthony Badsey-Ellis identified two more failed projects to tunnel under the Thames at Woolwich.

In 1904 parliament considered legislation for the North and South Woolwich Electric Railway. This was to be a short line passing under the river, with a station at Beresford Square and at the junction of Albert Road and High Street. The proposal was supported by both Woolwich and West Ham councils.

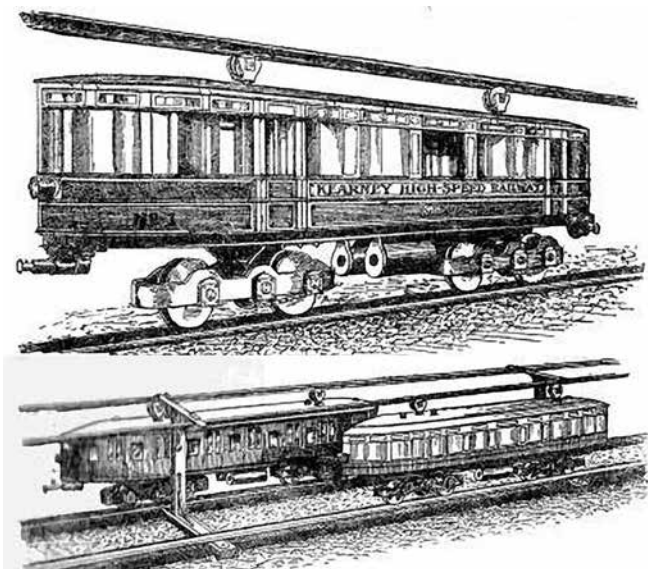
The London County Council supported the scheme, but asked for clauses in the enabling legislation. These would have prohibited the Railway Company from objecting to any subsequent council proposals for a tunnel, and would have disqualified the company from receiving compensation if a council tunnel were opened. These conditions were unacceptable to the scheme's promoters, so the legislation was withdrawn and the scheme forgotten. Only eight years later in 1912 the LCC opened the Woolwich foot tunnel.

Early monorail idea

Badsey-Ellis has also discovered a proposal in 1919 for a tunnelled electric monorail service between Beresford Square and North Woolwich station. It was the idea of the splendidly named Australian railway engineer Elfric Wells Chambers Kearney, who through the first half of the twentieth century promoted the 'Kearney High Speed Railway' as a solution to mass transport problems in cities around the world. His patented railway was unusual in that it would run on a single rail with four double-flanged wheels under each carriage; wheels mounted on the roof would run along an upper guide rail above the train. He claimed that the upper guide rail, along with the carriages' low centre of gravity, would stabilise the train on the lower rail thus preventing derailments and allowing greater speeds.

In July 1919, a House of Commons Select Committee investigating traffic problems in London visited Battersea to see a working model of Kearney's railway. A report in *The Times* (12 July) says that Kearney had plans for two lines – one from Cricklewood to Crystal Palace, and a second 'from Woolwich, under the river to East Ham'. I have not been able to find any other documentation for the Woolwich to East Ham proposal.

In January 1925 a delegation, including representatives of County Councils and London Local Authorities, met a parliamentary secretary of the Minister of Transport



Kearney's High Speed Railway. Each car is 45 feet long and equipped with two motors of 50hp each. Each car seats 46 people.

Colonel Moore-Brabazon to petition for more tube railways in London (*Times* 8 January 1925). The delegation was organised by 'The Kearney Society'. Elfric Kearney attended to explain the benefits of his system, which included claims that construction and operating costs would be much lower than conventional tube railways and would not require public subsidy.

The delegation asked the government to provide loan guarantees and enabling legislation so that a line could be built to demonstrate the benefits of the Kearney rail system. Woolwich to North Woolwich was one of two

schemes discussed as suitable for this. Mr E. Radford representing the Woolwich Chamber of Trade said that the scheme for Woolwich was 'an urgent necessity' and asked that it be built first.

Moore-Brabazon seems to have given a suitably diplomatic response. He said that more tube lines were needed, but no more money could be found to extend the current tube system, so Kearney's ideas for a cheaper system were welcome. He expressed concern that the Kearney rail system was incompatible with other rail systems in use, but said that the Trades Facilities Committee 'would probably guarantee interest on the necessary capital' for an experimental line to be built so that the benefits of wider adoption of the system could be evaluated.

I have not found any later documentation of this proposal for Woolwich and it is not clear whether plans were ever fully developed. The second pilot scheme, between North and South Shields, continued to be discussed occasionally for the next ten years, but like all of Kearney's schemes was never built.

Sources

- Kent County Archives, Q/Rum 631A
- London Metropolitan Archives, MBW/2632/17/15
- J. H. Greathead. *The City and South London Railway*. London, 1896
- House of Commons Parliamentary Papers, 1888
- A Badsey-Ellis. *London's Lost Tube Schemes*. Middlesex, 2005.
- Various regional newspapers.

Memories of Portsdown (2003 plus later additions 2010/11)

Steve Gilbert

During the late 1950s I was a pupil at Purbrook Park School. During games in the afternoon we would opt for 'cross country running' which meant we got off site and went where we wanted. We would usually go to Farlington Redoubt and mess about and have a smoke etc. We had heard the tales of tunnels under the hill, and at the time there was what appeared to be a ventilation chimney on the line from Fort Purbrook to the Redoubt. After a bit of scratching about we removed some of the bricks at ground level (on the blind side of Fort Purbrook!) and found there were iron steps set into the side of a vertical shaft leading down to a tunnel. (The logistics of getting out of school with tools, torches etc. were quite complicated!) The tunnel to the West led to a junction with, as I remember it, two other tunnels, one going northeast and the other roughly west. These were blocked by roof falls after a short distance. The tunnel to the east however continued for some distance (100 yds?) before again being blocked. The tunnel was about 5'6" high, or slightly more, and was wide enough to walk easily without rubbing the sides too often. The roof of the tunnel varied in height, in some places dropping 6"

or so quite smartly, causing a certain amount of swearing because of a banged head! Also for part, if not all of the way there was an iron pipe, about 6" diameter laid along the floor of the tunnel. As the walls tapered in towards the bottom this made walking a little more hazardous, as a turned ankle was more than a possibility.

We only went down two or three times, and later found that our access hole had been bricked up again. Clearly there were other people taking an interest!

On revisiting the area in 2010 I found that a new road, College Road, has been driven through via a cutting between Fort Purbrook and the Redoubt and this has gone through the area where the ventilation chimney was located. There is no indication on the sides of the new cutting where the tunnel was located.

Lately acquired information suggests that the tunnel we were in did not go to Farlington Redoubt, but in fact went to Crookhorne Redoubt, in which case the new cutting would have removed this tunnel completely, although the connection to Fort Purbrook must still exist, but now has been hidden by the road works.



Return to Daws Hill bunker – 23 March 2018

Martin Dixon



One of the Sub Brit groups about to venture underground. Photo Gerald Tompsett

As many members will know, RAF Daws Hill in High Wycombe served as the Headquarters of the 8th US Air Force in World War II. During 1942 a three-level bunker was built to act as a protected Operations Control Centre. The bunker was reused throughout the Cold War, with enhanced protection against nuclear blast, radioactive fallout and EMP (Electro Magnetic Pulse).

Ninety Sub Brit Members visited the site during 2015, with kind permission of the site owners, Wycombe Abbey Girls School. A full report of the site and this first visit appears in *Subterranea* 39 (August 2015). Everything went to plan and we were able to arrange a return visit in March this year when another 90 members enjoyed tours of this important site. Those attending travelled from near and far – the far including Cornwall and the Orkneys. We were particularly pleased that we were able to accommodate all those who applied for the visit.

The building is really two bunkers in one in two respects. Firstly the two periods of use (World War II and Cold War) led to very different layouts and facilities and by its closure in 1993 the Control Centre had become a large protected datacentre

with false floors, massive air conditioning, Halon fire protection and a high level of room by room security. The second reason that the bunker is ‘two in one’ is that an inner bunker sits within a ten-foot air gap surrounded by an outer bunker. Both inner and outer bunkers are protected with five or six feet of concrete, the air gap between providing protection against underground shock waves from bombardment. This rare feature is one of the reasons that the bunker is now protected as a Grade II* Listed Building.

Particular thanks are due to the volunteers who

welcomed those visiting and briefed and led the tours. We had hot drinks available and a small shop where we raised around £130 through the sale of bump caps and back copies of *Subterranea*.

We are fortunate to have developed an excellent relationship with the school and our next visit is planned to take some of their Old Girls round the bunker at one of their reunions later this year.



An aerial view of Daws Hill on the day of the visit. Photo Chris Wilkie



Discounted Cotswold Shopping

Cotswold Outdoor have granted Sub Brit members a 15% discount on their products (excluding sales and special offers). The details are included in a letter on the website at www.subbrit.org.uk/docs/discount-cotswold-outdoor.pdf

If you are not able to access the website, then please contact us with an SAE for a copy of the letter.

The discount code can be used in any of their 58 stores (there is a barcode on the letter), and for telephone and online orders.

**** Please do not share or abuse the code as this may lead Cotswold to withdraw it which would be a great shame and spoil things for the rest of our members. ****

Here is an introduction from David Hague of Cotswold:

“Cotswold Outdoor are proud to be a supporter of such a prestigious organisation as Sub Brit. As most of your members are aware, Cotswold Outdoor is a multi-award winning retailer with numerous thriving stores located nationwide. Not only are we proud of our knowledgeable staff, but our stores stock one of the most comprehensive ranges of outdoor clothing and equipment in the UK. With a huge range of footwear, waterproof jackets and fleeces, tents, sleeping bags and outdoor accessories, we offer one of the best selections of clothing and equipment right on your doorstep.

Whoever you are and whatever you need, when you shop with us you can be assured of expert, award-winning service and advice that comes from 40 years of experience in retailing. We're really looking forward to welcoming you to our store, online or over the phone soon. I hope that our discount helps your members purchase the right kit and equipment as they continue with their important and valued pastime. We are passionate about giving the right advice and recommending the right clothing and equipment so you can have peace of mind while out in (or should that be under!) the field.”



SPECIAL DISCOUNT

SUBBRIT are pleased to announce that we have negotiated a members' discount with

TORCH DIRECT LTD

Members can benefit from a 10% discount on all orders over £50

Website discount code **sub-brit10**

Please contact: Stewart King

01623 858990

support@torchdirect.co.uk



WWW.TORCHDIRECT.CO.UK

